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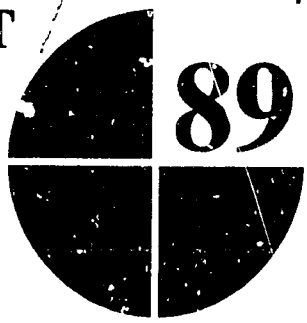

GROWTH IN JAPAN'S HORTICULTURAL TRADE WITH DEVELOPING COUNTRIES: AN ECONOMIC ANALYSIS OF THE MARKET

Masayoshi Honma

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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Research Report 89
International Food Policy Research Institute

Library of Congress Cataloging-in-Publication Data

Honma, Masayoshi, 1951-

Growth in Japan's horticultural trade with developing countries : an economic analysis of the market / Masayoshi Honma.

p. cm. — (Research report / International Food Policy Research Institute ; 89)

Includes bibliographical references.

ISBN 0-89629-092-1

1. Horticultural products industry—Japan. 2. Horticultural products industry—Developing countries. I. Title. II. Series: Research report (International Food Policy Research Institute) ; 89.

HD9016.J42H63 1991 91-43549

382'.415'0952—dc20 CIP

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FOREWORD

As the affluent populations in developed countries become more cosmopolitan as a result of technological advances in transportation and communications, their desire for exotic goods stimulates demand for nontraditional imports. This trend is particularly evident in fruits, vegetables, and cut flowers, and nowhere more so than in Japan. Noting that developed-country imports of horticultural products have increased steadily over the past decade, developing countries are increasingly adopting policies to encourage production of new varieties for export.

The need is great for developing countries to find nontraditional exports at a time when growth in the traditional ones is foundering. However, the pitfalls are many, and little research exists to provide guidance. In 1990, IFPRI published the first comprehensive analysis of world trade in horticultural products, *Horticultural Exports of Developing Countries: Past Performances, Future Prospects, and Policy Issues,* Research Report 80. That report placed high priority on the need for detailed country studies, especially of the major markets, that can guide developing countries in devising appropriate strategies for expanding their horticultural sectors. This study on Japan was undertaken in response to that call. It not only provides a wealth of useful data on the products and the exporting countries now competing in Japan, it also presents a broad overview of the structure of the Japanese market and the problems inherent in it.

Among the principal findings from the analysis, the importance of price changes in explaining supply shifts from one exporter to another indicates that Japan's horticultural imports are subject to significant price competition. Developing-country exporters are also concerned about Japan's phytosanitary regulations, the behavior of large traders, and the low efficiency of domestic distribution.

Just Faaland

Washington, D.C.
December 1991

ACKNOWLEDGMENTS

I am grateful to the International Food Policy Research Institute (IFPRI) for providing the opportunity for me to do research at IFPRI for two years as a visiting research fellow. During that time, I benefited from the comments and suggestions of many colleagues at IFPRI, in particular Nurul Islam, Alberto Valdés, Leonardo Paulino, and Romeo Bautista. My thanks are extended to Suthad Setboonsarng in Thailand, Min-Tze Wu in Taiwan, Audie Ugalino in the Philippines, and Ryuzo Koyama in Japan, who provided kind assistance and made arrangements for data collection and information gathering in each area. I am also indebted to Elizabeth Jacinto, my research assistant at IFPRI, who aided me in data processing at various stages of research. Last but not least, I would like to express my thanks to Yujiro Hayami for encouraging and stimulating me throughout the period of this research.

Masayoshi Honma

1

SUMMARY

International trade in horticultural commodities such as cut flowers, vegetables, and fruits is expanding at a higher rate than trade in other agricultural commodities. Although both demand and supply in current horticultural trade is dominated by developed countries, the rapid growth in international markets attracts many developing countries' attention because future expansion of agricultural exports from developing countries seems to lie in that direction. Because horticultural production is generally labor-intensive, developing countries with abundant labor relative to capital and land have a comparative advantage in horticulture.

This study explores the possibilities and opportunities for expansion of horticultural exports from developing countries to a rapidly growing single market—Japan. Japan increased its horticultural imports by 12.5 percent annually in value during the 1980s, while its growth rate for total agricultural imports stayed at 5.2 percent annually. Japan is now the fifth largest importer of fruits and vegetables in the world; it accounted for 7.1 percent of total imports of fruits and vegetables by all the market economies on average during the three-year period, 1986-88. Developing countries supplied 39 percent of Japan's total imports of horticultural commodities in value in 1988, compared with 47 percent in 1980. The developing countries' share was reduced because they could not compete with rapid increases in exports of vegetables, particularly processed vegetables, from developed countries to Japan. However, developing countries were well able to cope with competition from other exporters of fruit to Japan.

Japan is not only increasing the volume of its horticultural imports, it is also expanding the range of commodities imported. But trade statistics are not disaggregated enough to cover most new commodities in detail. For this study, 14 commodities were selected for analysis, with emphasis on imports from developing countries: cut flowers, onions, green beans, dried and canned bamboo shoots, pickled and nonpickled ginger, bananas, mangoes, avocados, kiwifruit, and fresh, frozen, and canned pineapple. These 14 commodities accounted for about 30 percent of the total value of horticultural products imported by Japan on average in 1987-89. Major suppliers of these commodities to Japan are mainland China, Mexico, the Netherlands, New Zealand, the Philippines, Taiwan, Thailand, and the United States. A look at Japan's market shows that imports of the same commodity may perform differently in both quantity and price, depending on their source of supply. Horticultural products are characterized by diversity of varieties and variability of production seasons in supplying countries. Therefore, it is natural to distinguish horticultural imports not only by commodity but also by source of supply.

Investigation of Japan's horticultural import behavior is based on a two-stage budgeting procedure. In the first stage, expenditure on imports of a commodity—

mango, for example—is determined. In the second stage, expenditure is allocated among individual import products from different countries, say, mangoes from the Philippines and Mexico. Based on this theory of product differentiation, the characteristics of Japan's horticultural import demand are captured by estimating two types of import demand equations: the first-stage import demand equations, which represent total demand for imports of a commodity, and the second-stage trade-flow equations, which are expressed as a function of individual import prices received by each supplier of the commodity and the total import expenditure on all imports of that commodity.

The empirical estimations of the first-stage import demand equations show great sensitivity to changes in prices of imports of cut flowers, nonpickled ginger, mangoes, avocados, and kiwifruit. Canned bamboo shoots, bananas, and fresh pineapple were also fairly price sensitive. Income elasticities, which represent the sensitivity of imports to Japan's income changes, were significant for imports of cut flowers, canned bamboo shoots, pickled ginger, mangoes, and canned pineapple. It appears that most of the horticultural commodities included in this study are more sensitive to price and income changes than are other agricultural commodities.

The import demand characteristics of a commodity, however, are not shared equally by all the trade flows of that commodity. Most trade flows resulted in significant own-price coefficients in the estimation of second-stage trade-flow equations, but the degree of sensitivity to price changes differs from one trade flow to another. It is natural to expect varying degrees of sensitivity because each country provides different varieties of the commodity, which do not substitute perfectly for products from other suppliers. Even the commodities whose price elasticities are relatively small—some vegetables, for example–show great sensitivity to price changes in trade flows. This means that Japan's consumers and traders are seeking cheaper products, so that price competition among foreign suppliers is inevitable.

Japan's preferences for imports by source of supply, given relative prices, are captured by estimating coefficients of the import expenditure variable in trade-flow equations. Statistically, 13 trade flows out of a total of 31 have been favored with market growth; their shares tend to increase even when there is no change in relative prices, as Japan's total imports of the commodity increase. On the other hand, there are 6 trade flows that statistically appear to be losing market share as Japan's horticultural imports grow.

The estimation results of the first-stage import demand and the second-stage trade-flow equations are combined to obtain the total effects of price and income changes on trade flows. The calculated own-price and income elasticities by trade flow provide useful information to help exporting countries decide on appropriate strategies for expanding their horticultural exports to Japan. The study shows that for 20 trade flows out of a total of 31, exporting countries could increase not only the quantity they export but also export earnings if they could reduce their prices by reducing the costs of production, marketing, and distribution.

The calculated income elasticities of individual trade flows are divided into two groups, one group having a very large average income elasticity and the other a very low one. Some trade flows resulted in a low income elasticity even though they are part of a family of commodities with large income elasticities because the coefficient of the import expenditure variable is small in the trade-flow equations.

Based on elasticities calculated for trade flows, the contribution of each variable to changes in annual import growth rates by trade flow are determined. For many exporting countries, changes in their own prices were the major reason for changes in growth in Japan's market. Changes in competitors' prices also explained the growth in some trade flows. The importance of price changes in explaining shifts from one exporter to another indicate that Japan's horticultural imports are subject to severe price competition.

However, nonprice competition also plays an important role in growth in Japan's market. For example, sales promotions by exporters have had significant effects on exports of cut flowers from the Netherlands and bananas and mangoes from the Philippines. In addition, the Netherlands has benefited from preshipment inspection of cut flowers, which reduces the risk of rejection due to quarantine regulations on arrival at Japan's ports. The market structure is also important for understanding the growth of horticultural imports. If the market is not completely open to competition, the pricing mechanism is affected by the behavior of large traders and so is the import quantity.

Import growth of horticultural commodities is also subject to Japanese policy. Exporting countries are particularly concerned about Japan's phytosanitary regulations. Although it is difficult to separate unnecessary restrictions from necessary ones, the system of restrictions and its background should be examined carefully. Some complaints by exporting countries are directed at the operation of regulations rather than at the regulations themselves because the number of inspectors has not proportionally increased relative to the increases in horticultural imports, which has resulted in delay and congestion in inspections and custom clearances.

The efficiency of domestic distribution in Japan is also a concern. Distribution costs for vegetables and fruits account for 50-70 percent of retail prices in Japan. To judge Japan's distribution efficiency, this figure should be compared with other countries' data, but it seems possible to reduce costs by integrating distribution. Retail costs for vegetable and fruit sales in supermarkets are 20 percent less than those in small shops. According to an evaluation of assumed policy changes in Japan, if the Large Retail Store Law, which regulates the opening of major retail operations, were abolished, and through competition, all the retail shops could make their sales operations as efficient as the supermarkets, it would cause a more than 10 percent increase in imports of some commodity flows.

The importance of distribution costs is emphasized in international price linkages, too. In an examination of import prices in Japan and corresponding export prices in exporting countries for 16 trade flows, international transportation costs and margins are found to vary widely, and in some trade flows, the international distribution costs account for 70 percent of the import price. It also appears that export price changes and exchange rate changes are not fully transmitted to import price changes in international distribution.

Finally, supplyside conditions are examined, using a linearly homogeneous production function, to see what determines export prices. Export price changes in this framework are a function of wage rate and capital rental changes weighted by cost shares. The residuals in export price changes are interpreted as the effects of technological progress. Export price examinations indicate that high labor costs exert pressure on most horticultural products in Taiwan and possibly improve efficiency in Thailand's production of some horticultural commodities.

In conclusion, this study finds that Japan's horticultural import growth has derived from both price and nonprice factors. However, it must be emphasized that further investigations of domestic and international distribution systems for horticultural products and the role of governments in both importing and exporting countries are necessary. To accomplish these goals, detailed statistics are needed.

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OVERVIEW OF JAPAN'S HORTICULTURAL IMPORTS

International trade of horticultural products such as cut flowers, fruits, and vegetables is attracting much attention from agricultural trade researchers because of its rapid expansion in recent years. This expansion of horticultural trade is related to several factors. One is the change in food consumption patterns brought about by a rise in health consciousness; consumers, especially in developed countries, are avoiding high-calorie, high-cholesterol foods. Vegetables and fruits play an important role in this changing dietary pattern. Other factors are the remarkable technological improvements in transportation and the increased availability of air transport. These developments in transportation make it possible to ship perishable products internationally at lower costs. Also, the increase in the number of international travelers contributes to the growth in horticultural trade because eating experiences abroad help stimulate demand for new fruits and vegetables at home.

Many developing countries are interested in expanding horticultural trade, which could contribute to agricultural diversification, employment opportunity, and foreign exchange earnings in developing countries. Developing countries with abundant labor relative to capital and land are believed to have a comparative advantage in horticultural products, which are generally labor-intensive.

Despite the increasing importance of horticultural trade in the world market, the research results in this sector are limited. In the literature, several studies exist that examine production and potential exports of horticultural commodities in developing countries. The Institute for Horticultural Economics in Germany conducted studies on export-oriented horticulture in some African countries (Hörmann and Wietor 1980; Hörmann 1981; Hörmann and Will 1987). The U.S. Agency for International Development examined horticultural exports in El Salvador, Jamaica, and Kenya (Daines and Hargreaves 1985; Buckley 1986; Jaffee 1986). And IFPRI investigated the effects of nontraditional horticultural exports on a rural economy in Guatemala (von Braun, Hotchkiss, and Immink 1989).

Trade studies on horticultural commodities are mostly related to regional competitiveness in horticultural products. For example, the U.S. Department of Agriculture conducted a study on the competition between Florida and Mexico for vegetable trade (Buckley et al. 1986), and several California study groups have examined the market conditions for exports of California specialty crops (Moulton et al. 1986; Stamoulis et al. 1989). Horticultural trade in Europe and Northern Africa was considered in the process of expanding the European Community to include Greece in 1981 and Spain and Portugal in 1986 because these countries have a comparative advantage in horticulture and would cause changes in horticultural trade patterns when they joined the European Community. Studies by Sarris

(1983) and the World Bank (Pole 1986) examine the effects of the expanded European Community on horticultural trade.

In terms of coverage of commodities and countries, the most comprehensive study of developing-country horticultural trade is provided in a recent IFPRI research report (Islam 1990). Islam suggests that detailed country studies are needed to help developing countries devise appropriate strategies for expanding their horticultural sectors. Following Islam's suggestion, this report focuses attention on the rapidly growing Japanese market. Japan's imports of horticultural products have been rapidly increasing. Japan is now the fifth largest importer of vegetables and fruits in the world market, following Germany, the United States, the United Kingdom, and France. During 1986-88, Japan accounted for 7.1 percent of total imports of vegetables and fruits by market economy countries (Table 1). This report aims to examine Japan's import behavior regarding horticultural products and to determine the sources of its import growth, with special emphasis on trade flows from developing countries. Before going into a detailed analysis of Japan's import behavior, it may be useful to start with an overview of the structure of Japan's horticultural imports.

Growth of Horticultural Imports

The import value of Japan's horticultural products in U.S. dollars increased by 16.3 percent a year during the 1970s, which was about the same growth rate as total agricultural imports (Table 2). This high growth rate stemmed from increases in

Table 1—Value of vegetables and fruits imported by five major importing countries from market economy countries, 1986-88 average

Country	Vegetables	Fruits	Total Horticultural Imports
		(US$ million)	
Germany, Federal Republic of	3,396 (20.9)	4,035 (17.8)	7,431 (19.1)
United States	1,497 (9.2)	3,566 (15.7)	5,063 (13.0)
United Kingdom	1,530 (9.4)	2,247 (9.9)	3,777 (9.7)
France	1,483 (9.1)	2,252 (9.9)	3,736 (9.6)
Japan	1,009 (6.2)	1,753 (7.7)	2,762 (7.1)
Total market economy imports	16,220 (100.0)	22,705 (100.0)	38,925 (100.0)

Source: United Nations, *Yearbook of International Trade Statistics* (New York: UN, various years).
Notes: Imports from the centrally planned economies are not included. Figures in parentheses are percentages of the total imports of the market economies.

Table 2—Value and growth of horticultural products imported by Japan, 1970, 1980, and 1988

Imports	Import Value			Growth Rate/Year	
	1970	1980	1988	1970-80	1980-88
	(US$ million)			(percent)	
Cut flowers[a]	0.3 (0.0)	19 (0.1)	108 (0.4)	50.9	24.4
Vegetables[b]	72 (1.7)	548 (3.1)	1,484 (5.5)	22.5	13.3
Fruits[c]	237 (5.7)	838 (4.7)	2,004 (7.5)	13.5	11.5
Total horticultural	310 (7.5)	1,405 (7.9)	3,596 (13.4)	16.3	12.5
Total agricultural	4,144 (100.0)	17,811 (100.0)	26,805 (100.0)	15.7	5.2

Sources: United Nations, *Commodity Trade Statistics.* (New York: UN, various years); Food and Agriculture Organization of the United Nations, *FAO Trade Yearbook* (Rome: FAO, various years).
Note: Figures in parentheses are percentages of total agricultural imports.
[a]Includes foliage.
[b]Includes potatoes and pulses.
[c]Includes nuts, except oil nuts.

import quantity, as well as from price increases due to the first oil crisis and to the world food crisis in the mid-1970s. The growth in total agricultural imports in the 1970s, however, was mostly due to price increases.[1]

In the 1980s, the value of total agricultural import growth slowed to a 5.2 percent rate of annual increase, but horticultural imports continued to grow 12.5 percent a year (Table 2).[2] Therefore, the share of horticultural imports in total agricultural imports—7.9 percent in 1980—increased to 13.4 percent by 1988.

The rapid increase in horticultural imports also changed the role of foreign products in the total supply of horticultural products to Japanese consumers. Table 3 shows shares of imports of cut flowers, vegetables, and fruits in total supply. Cut-flower imports were negligible in 1970, but accounted for 5.1 percent of the value of total supply in 1988. Imported vegetables accounted for 7.2 percent in 1988, and imported fruits, which play the most important role in horticultural imports, accounted for 24 percent of the expenditure on fruits. On average, horticultural imports held an 11.6 percent share of the value of total supply in 1988. The ratio is increasing as Japan becomes more dependent on imports for the supply of horticultural products.

[1]Import quantity indices of vegetables and fruits increased by 11.9 percent and 6.8 percent annually from 1970 to 1980, while the index of annual growth of the quantity of total agricultural imports stayed at 4.0 percent during the same period (JMAFF 1989a).

[2]Increases in the import quantity index for 1980-88 were at 8.2 percent and 7.0 percent annually for vegetables and fruits, respectively, while increases in the total agricultural import quantity recorded a 5.5 percent annual growth rate (JMAFF 1989a).

Table 3—Share of imports in the value of the total supply of horticultural products, Japan, 1970, 1980, and 1988

Imports	1970	1980	1988
		(percent)	
Cut flowers[a]	0.3	2.4	5.1
Vegetables[b]	2.9	5.3	7.2
Fruits[c]	17.7	21.6	24.0
Total horticultural	7.8	9.4	11.6
Total agricultural	24.2	28.2	24.5

Sources: United Nations, *Commodity Trade Statistics* (New York: UN, various years); Food and Agriculture Organization of the United Nations, *FAO Trade Yearbook* (Rome: FAO, various years); and Japan, Ministry of Agriculture, Forestry and Fisheries, *Statistical Appendix to the Agricultural White Paper* (Tokyo: JMAFF, 1989).

Note: Based on the ratio of the value of imports to the sum of the values of imports and domestic production.

[a]Includes foliage.

[b]Includes potatoes and pulses.

[c]Includes nuts, except oil nuts.

Japan imports horticultural products from a number of countries all around the world (Table 4). In 1980 developing countries supplied 47 percent of Japan's total horticultural imports, but their annual growth rate was 9.8 percent, which was below the market growth rate of 12.5 percent, causing the development countries' market share to fall to 39 percent by 1988. Among developing countries, Asian countries are the most important, accounting for one-third of Japan's total horticultural imports in 1988. It is noteworthy, however, that other developing-country regions have increased their importance in Japan's market, with a remarkably high

Table 4—Value and share of horticultural products imported by Japan, by region of supply, 1980 and 1988

Country Group	1980		1988		Growth Rate/Year
	Value	Share	Value	Share	
	(US$ million)	(percent)	(US$ million)	(percent)	(percent)
Developing countries	663	47.2	1,402	39.0	9.8
Asia[a]	640	45.5	1,222	34.0	8.4
Latin America	15	1.1	119	3.3	29.2
Others	8	0.6	61	1.7	28.5
Developed countries	574	40.8	1,558	43.3	13.3
United States	452	32.1	1,103	30.7	11.8
Others	123	8.7	455	12.7	17.8
Centrally-planned economies	168	12.0	635	17.7	18.1
China[a]	147	10.5	595	16.5	19.0
Others	21	1.5	40	1.1	8.6
Total	1,405	100.0	3,596	100.0	12.5

Source: United Nations, *Commodity Trade Statistics* (New York: UN, various years).

Note: Horticultural imports include cut flowers and foliage, vegetables, fruits, and nuts, excluding oil nuts.

[a]Taiwan is included in China, not in Asia.

annual growth rate of 29.2 percent for Latin American countries and 28.5 percent for other developing countries during the period 1980-88. But developing-country regions other than Asia accounted for only 5 percent of Japan's total horticultural imports in 1988.

Developed countries supply more than 43 percent of Japan's horticultural imports, and the United States plays a dominant role as the most important single supplier, with a share of about 31 percent in Japan's market. However, other developed countries have recently emerged as significant suppliers of horticultural products to Japan, accounting for 13 percent of Japan's imports in 1988. Centrally planned economies, mainly China (including Taiwan), also supply substantial amounts of horticultural products to Japan—18 percent—and their growth rate is higher than average.

In order to examine the performance of developing countries in detail, Tables 5 and 6 provide data on the value and quantity of Japan's horticultural imports by commodity group, comparing developing countries with others in 1980 and 1988. Developing countries were competitive in both fresh and processed fruits, and their growth rates in value were comparable to others in these two commodity groups. However, developing countries were far behind in cut flowers and vegetables. There was a particularly large difference between developing countries and other countries in processed vegetables during 1980-88; whereas the annual growth rate for other countries was 26 percent, that of developing countries stayed at 8.3 percent. This resulted in a sharp decline of developing countries' share in processed

Table 5—Value and share of horticultural products imported by Japan from developing countries, by commodity group, 1980 and 1988

Imports/ Country Group	1980		1988		Growth Rate/Year
	Value	Share	Value	Share	
	(US$100,000)	(percent)	(US$100,000)	(percent)	(percent)
Cut flowers[a] from					
Developing countries	151	80	534	49	17.1
Others	38	20	550	51	39.6
Fresh vegetables[b] from					
Developing countries	1,868	50	3,130	38	6.7
Others	1,860	50	5,215	62	13.8
Processed vegetables[c] from					
Developing countries	1,040	59	1,971	30	8.3
Others	714	41	4,523	70	26.0
Fresh fruits[d] from					
Developing countries	2,592	40	6,150	40	11.4
Others	3,853	60	9,350	60	11.7
Processed fruits[e] from					
Developing countries	980	51	2,271	49	10.9
Others	958	49	2,296	51	11.5

Source: United Nations, *Commodity Trade Statistics* (New York: UN, various years).
[a]Includes foliage.
[b]Includes dried and shelled legumes and frozen or provisionally preserved vegetables.
[c]Prepared or preserved vegetables.
[d]Includes nuts, except oil nuts.
[e]Prepared or preserved fruits.

Table 6—Quantity and share of horticultural products imported by Japan from developing countries, by commodity group, 1980 and 1988

Imports/ Country Group	1980		1988		Growth Rate/Year
	Quantity	Share	Quantity	Share	
	(100,000 metric tons)	(percent)	(100,000 metric tons)	(percent)	(percent)
Cut flowers[a] from					
Developing countries	40	90	99	72	11.9
Others	4	10	39	28	32.2
Fresh vegetables[b] from					
Developing countries	2,533	48	4,199	44	6.5
Others	2,724	52	5,391	56	8.9
Processed vegetables[c] from					
Developing countries	1,028	62	1,219	25	2.2
Others	638	38	3,622	75	24.2
Fresh fruits[d] from					
Developing countries	8,429	68	9,297	58	1.2
Others	3,885	32	6,769	42	7.2
Processed fruits[e] from					
Developing countries	711	49	1,227	44	7.1
Others	732	51	1,553	56	9.9

Source: United Nations, *Commodity Trade Statistics* (New York: UN, various years).
[a]Includes foliage.
[b]Includes dried and shelled legumes and frozen or provisionally preserved vegetables.
[c]Prepared or preserved vegetables.
[d]Includes nuts, except oil nuts.
[e]Prepared or preserved fruits.

vegetables from 59 percent in 1980 to 30 percent in 1988. There was also a big difference in the growth rate of cut-flower imports from developing countries and others, reflecting a rapid increase in participation of others in Japan's market. The overall horticultural import growth rate for developing countries—9.8 percent per year for 1980-88—was much higher than the import growth rate of other agricultural products, but lower than the growth rate of horticultural imports from other countries, as a result of the decline in processed vegetable imports.

During the same period, there was a significant difference between developing countries and others in the growth rate of the quantity of fresh fruit imports (Table 6), despite the similarity in the value growth rate. The differences between growth rates of value and quantity are attributed to price changes and changes in the commodity composition of imports. In other words, high value growth indicates that Japan is increasingly importing more expensive fresh fruits from developing countries. In contrast, the growth rate for quantity of fresh vegetable imports from developing countries is about the same as the value growth rate, meaning that developing countries are exporting less expensive fresh vegetables to Japan, while other countries are shifting to exports of more expensive fresh vegetables.

Commodities in Horticultural Imports

What types of horticultural commodities are imported by Japan? Japan's imports of horticultural commodities may be classified into four categories according

to the role they play in the Japanese market. The first group includes commodities that are imported when domestic produce is in short supply or out of season. The role of imports in this category is to make the commodities available in all seasons, supplementing domestic production rather than conflicting with it. Onions, for example, have traditionally been imported in this manner. Pumpkins and asparagus are imported in winter when little domestic produce is marketed.

The second category of horticultural imports includes commodities that are seldom produced domestically. Because there is no conflict with domestic products, imports of commodities in this group were liberalized soon after World War II. Most tropical fruits and specialties like nuts are included in this group.

The third group is the commodities to be processed, especially pickled vegetables. Imports of commodities in this group are preserved, at least provisionally, in brine, in sulphur water, or in other preservative solutions, which avoids problems with Japan's plant regulations and makes the supply relatively stable. There is a steady demand in Japan for pickled vegetables, but domestic products have been replaced with much cheaper imports, as homemade pickles became less common and most pickles are processed in factories. Examples in this group are ginger, cucumber, eggplant, and bracken.

The fourth group consists of all the rest of the imported horticultural products, which are characterized by rapid increases in demand. Most fruits and vegetables in this group were introduced relatively recently. This reflects the internationalization of Japan's eating habits, as a result of notable increases in overseas travel and wider information from abroad through mass media. The dynamic increases in demand for new and nontraditional horticultural products from abroad have been supported by the strong Japanese currency, which appreciated from 239 yen (Y) to the U.S. dollar in 1985 to Y128 in 1988. Therefore, many products that used to be unprofitable to import are now on the traders' list of imports.

Among vegetable imports, onions used to be the most important vegetable, by weight, though imports of onions fluctuate from year to year (Table 7).[3] Recently, however, frozen potatoes have emerged as the number one single item, by weight, among vegetable imports. Most imported frozen potatoes are cooked French fries, which are served at fast-food and U.S.-style family restaurants in Japan. These businesses have shown incredible growth: in 1988 there were 3,303 fast-food outlets with sales of more than US$2.8 billion, and 1,485 family restaurants with sales of US$2.2 billion, compared with 1,039 fast-food outlets and 578 family restaurants in 1980 (USDA 1990a, 16). This increase in frozen potatoes, together with increases in other frozen cooked vegetables, contributed greatly to the rapid import growth rate of processed vegetables from other countries in Tables 5 and 6.

In Table 7, pumpkins, at 41.8 percent, and asparagus, at 35.9 percent, show remarkably high annual growth rates. As mentioned already, both commodities are imported in seasons when domestic production is out of season. Both commodities owe their success to increasing general demand for healthy foods, especially green

[3]Annual data for onion imports in Table 7 are 72,819 tons in 1979, 76,977 tons in 1980, 205,056 tons in 1981, 35,475 tons in 1987, 112,443 tons in 1988, and 80,780 tons in 1989. In this report, all tons refer to metric tons.

Table 7—Quantity of horticultural products imported by Japan, by commodity, 1979-81 and 1987-89

Commodity	1979-81	1987-89	Growth Rate/Year	Major Suppliers
	(metric tons)		(percent)	
Cut flowers	2,627	10,311	18.6	Thailand, Netherlands, Taiwan
Selected vegetables				
Onions	118,284	76,233	-5.3	United States, New Zealand, Taiwan
Garlic	2,607	3,245	2.8	China, Argentina
Shallots	32	264	30.2	France
Matsutake	481	1,784	17.8	Korea (Republic of), China, Korea (Democratic People's Republic of)
Asparagus	901	10,488	35.9	United States, Mexico, Australia
Pumpkins	4,528	74,041	41.8	New Zealand, Mexico, Colombia
Green beans	48,439	52,703	1.1	Thailand
Bamboo shoots, dried	3,953	3,820	-0.4	China, Taiwan
Bamboo shoots, canned	32,165	74,690	11.1	China, Taiwan, Thailand
Ginger, nonpickled	1,967	4,483	10.9	China, Taiwan, Thailand
Ginger, pickled	31,014	46,249	5.1	Thailand, Taiwan
Pulses, frozen[a]	55,516	81,352	4.9	Taiwan, United States, China
Sweet corn, frozen	24,939	35,045	4.3	United States, New Zealand
Potatoes, frozen[b]	29,363	114,269	18.5	United States, Canada
Selected fresh fruits				
Bananas	741,360	769,657	0.5	Philippines, Taiwan, Ecuador
Pineapple	112,344	139,406	2.7	Philippines, Taiwan
Mangoes	1,288	5,622	20.2	Philippines, Mexico
Avocados	720	3,762	22.9	United States, Mexico
Oranges	66,982	122,381	7.8	United States
Lemons and limes	104,405	119,797	1.7	United States
Grapefruit	153,851	238,374	5.6	United States, Israel
Grapes	1,367	6,965	22.6	United States, Chile, Taiwan
Cherries	2,180	9,166	19.7	United States
Melons[c]	4,259	18,649	20.3	United States, Mexico, New Zealand
Berries	1,074	2,750	12.5	United States, New Zealand
Papaws	2,722	5,108	8.2	United States
Kiwifruit	8,100[d]	53,747	37.1	New Zealand, United States

Sources: Japan Tariff Association, *Japan Exports and Imports (Commodity by Country)* (Tokyo: JTA, various years); Japan Vegetable and Fruit Import Safety Promotion Association, *Statistical Data of Imported Vegetables and Fruits* (Tokyo: JVFISPA, 1990).

[a]Pulses include peas, cowpeas, kidney beans, and green soybeans.

[b]Includes cooked potatoes.

[c]Includes watermelons.

[d]1981-83 average.

vegetables. For this reason, green asparagus has driven out white asparagus, which used to be dominant.

Among imported fruits, bananas are the most important commodity, with imports of 770,000 tons on average in 1987-89, (Table 7), followed by grapefruit (238,000 tons), pineapple (139,000 tons), oranges (122,000 tons), and lemons and limes (120,000 tons). From 1979-81 to 1987-89, kiwifruit recorded the highest annual growth rate—37 percent. Other commodities with high annual growth rates are avocados and grapes (23 percent), and mangoes, cherries, and melons (20 percent). The range of fruits imported is expanding as new fruits are introduced in Japan, but the major suppliers are limited to a handful of countries, including the United States and developing countries in the tropical zone.

Only the commodities that are identified in Japan's trade statistics based on customs clearance are listed in Table 7. Despite increases in the number of commodities included in Japan's trade statistics corresponding to the change from the Customs Cooperation Council Nomenclature (CCCN) classification to the Harmonized Commodity Description and Coding System (HS) classification in 1988, the commodity coverage is not enough to follow the new developments in Japan's horticultural imports. Some other fresh fruits and vegetables are listed in Table 8; these are taken from import quantity data collected by the Japan Vegetable and Fruit Import Safety Promotion Association. Litchis among the fruits and garlic sprouts, broccoli, and snow peas among the vegetables have increased dramatically. The association listed 64 fresh fruits and 163 fresh vegetables in 1989 that

Table 8—Major fresh fruits and vegetables imported by Japan but not classified in Japan's trade statistics, 1987, 1988, and 1989

Commodity	1987	1988	1989	Major Suppliers
		(metric tons)		
Fruits				
Limes	570	739	922	Mexico
Tangelos	91	111	200	New Zealand, United States
Watermelons	133	107	106	United States, Mexico, Republic of Korea
Hamigua melons	0	766	379	China
Pomegranates	1,046	597	456	United States, Iran
Persimmons	69	107	138	New Zealand
Durians	63	104	89	Thailand, Philippines
Litchis	961	1,149	1,485	Taiwan
Passion fruit	18	15	15	New Zealand, United States
Cherimoyas	51	60	56	United States
Vegetables				
Garlic sprouts	5,396	5,952	6,180	China, Republic of Korea
Leek	89	176	234	Australia, Belgium
Cabbages	1,316	3,433	2,519	Taiwan, Republic of Korea
Broccoli	347	2,207	5,361	United States, Taiwan
Red salad	122	158	252	Italy, New Zealand
Cauliflowers[a]	n.a.	756	697	United States, Taiwan
Mushrooms[a]	n.a.	1,075	1,013	Taiwan, Canada
Chicory[a]	n.a.	451	519	Belgium, Netherlands
Carrots	2,165	799	1,101	Taiwan, United States, Republic of Korea
Edible burdocks	167	260	832	Taiwan
Edible lotus roots	26	108	193	China, Hong Kong
Green peas	302	236	250	Taiwan, China
Snow peas	2,513	1,696	4,855	Taiwan
Green soybeans	2,846	3,029	1,226	Taiwan
Okra	529	803	1,421	Thailand, Philippines
Celery[a]	n.a.	589	410	United States
Water chestnuts	106	172	237	China
Baby corn	67	177	134	Thailand, Philippines
Sweet corn[a]	n.a.	429	345	New Zealand, Taiwan

Source: Japan Vegetable and Fruit Import Safety Promotion Association, *Statistical Data of Imported Vegetables and Fruits* (Tokyo: JVFISPA, 1990).
Notes: These import quantities were recorded at seven major ports. n.a. is not available.
[a]These vegetables have been classified in trade statistics since 1988.

are not classified in the government trade statistics in addition to 37 fruits and 28 vegetables that are available in trade statistics.[4]

Commodities Selected for Research

Japan's dynamic import behavior provides a good indication of many aspects of the new trends in the world horticultural market. But detailed data on horticultural commodities are still limited to a small number of commodities. With these limitations and the focus of this study on developing countries, 10 commodities from Table 7 have been selected for detailed analysis. These are cut flowers, onions, green beans, bamboo shoots, ginger, bananas, pineapple, mangoes, avocados, and kiwifruit.[5] Bamboo shoots are further classified into two types, dried and canned, because they are different varieties and different in use. Differentiation is also made between ginger that is preserved (hereafter called "pickled ginger") and that which is not preserved (called "nonpickled ginger") because of their different uses. Frozen and canned pineapple, as well as fresh pineapple, play important roles in Japan's imports and in some developing country's exports; therefore all three types of pineapple are included. In total, 14 commodities are analyzed. Imports of these 14 commodities accounted for about 30 percent of the value of total horticultural imports in Japan during 1987-89. The major suppliers of these commodities are Taiwan, Thailand, the Philippines, Mexico, New Zealand, the Netherlands, the United States, and mainland China (Peoples Republic of China, hereafter called China). Each exports at least one of the 14 commodities to Japan.

Table 9 indicates the trade flows for the selected 14 commodities during the period 1979-81 to 1987-89. The growth of the value of imports varies greatly not only by commodity but also by source of imports. There is no commodity that has an even growth rate among its suppliers. Differences among suppliers are particularly large in cut flowers, prepared bamboo shoots, and pickled ginger; for the latter two commodities even the direction of growth is different between Taiwan and other suppliers. Foreign suppliers may be more interested in the value growth rates in U.S. dollars. During the period 1979-81 to 1987-89, the Japanese yen appreciated 62 percent so that the growth rates of import value in U.S. dollars were further increased by 5.9 percent annually above the rates expressed in yen. Therefore, all the foreign suppliers enjoyed higher earnings in U.S. dollars on horticultural exports to Japan than is shown in Table 9.

The import growth rates in value are subject to changes in both import quantity and import price. Table 9 presents movements in both quantity and price by trade flow. It is important to note that not only import quantities but also prices show different movements by source of supply for the same vegetable. Again, for some

[4]Only import quantity data recorded at seven major ports are available for those fresh fruits and vegetables that are not classified in the trade statistics.

[5]Although asparagus and pumpkins are important imported vegetables in Japan and should be included in the analysis, trade data have been recorded only since 1988, and there are no price data available before that. Although kiwifruit are supplied by developed countries, they are included because their rapid growth may have implications for developing countries.

Table 9—Growth and price changes for Japan's imports of selected horticultural products, by country of origin, 1979-81 to 1987-89

Commodity/ Country of Origin	Import Value, 1987-89 Average	Growth Rate of Import Value	Growth Rate of Import Quantity	Change in Import Price/Year
	(Y million)		(percent)	
Cut flowers				
Taiwan	1,369	5.8	12.8	-5.8
Thailand	3,802	14.8	21.6	-5.2
Netherlands	3,738	84.2	93.0	-8.1
Total	12,225	16.7	18.6	-1.4
Onions				
Taiwan	538	-7.2	-3.4	-3.7
United States	1,580	-13.2	-4.9	-7.7
New Zealand	790	-12.9	-6.3	-6.3
Total	3,839	-11.8	-5.3	-5.9
Green beans				
Thailand	2,002	-8.2	-2.1	-6.3
Total	3,677	-4.8	1.1	-5.8
Bamboo shoots, dried				
Taiwan	5,370	4.7	-1.4	6.0
China	319	29.9	21.6	6.0
Total	5,701	5.2	-0.4	5.5
Bamboo shoots, canned				
Taiwan	2,628	-6.3	-8.1	0.9
Thailand	1,556	46.4	41.1	2.7
China	7,633	46.3	54.9	-5.9
Total	11,898	11.7	11.1	-0.3
Ginger, nonpickled				
Taiwan	412	11.3	10.6	0.7
Thailand	13	33.7	44.5	-6.4
China	275	3.3	12.0	-8.7
Total	783	6.6	10.9	-3.4
Ginger, pickled				
Taiwan	989	-11.9	-13.8	2.3
Thailand	3,113	36.2	36.9	-0.4
Total	4,564	5.1	5.1	-0.2
Bananas				
Taiwan	7,571	1.5	0.7	-1.6
Philippines	42,902	1.5	-1.2	0.4
Total	56,557	2.9	0.5	0.1
Mangoes				
Philippines	1,516	22.1	27.6	-4.3
Mexico	522	4.0	7.6	-3.2
Total	2,087	14.5	20.2	-4.7
Avocados				
Mexico	220	13.2	26.4	-10.6
United States	789	14.1	22.2	-6.7
Total	1,013	13.9	22.9	-7.5
Kiwifruit				
New Zealand	14,675	21.3	40.6	-14.8
Total	15,366	17.4	37.1	-15.3
Pineapple, fresh				
Taiwan	872	14.7	7.4	6.3
Philippines	8,829	-0.2	2.5	-2.6
Total	9,732	0.6	2.7	-2.1
Pineapple, frozen				
Taiwan	3	-47.4	-50.7	8.8
Thailand	1,034	-1.6	5.0	-7.1
Total	1,188	-4.9	0.7	-6.3

(continued)

Table 9—Continued

Commodity/ Country of Origin	Import Value, 1987-89 Average	Growth Rate of Import Value	Growth Rate of Import Quantity	Change in Import Price/Year
	(Y million)		(percent)	
Pineapple, canned				
Taiwan	284	-14.9	-12.3	-3.9
Philippines	1,046	-3.4	1.5	-5.8
Thailand	983	3.9	9.6	-6.1
Total	2,958	-3.0	1.9	-5.8

Source: Japan Tariff Association, *Japan Exports and Imports (Commodity by Country)* (Tokyo: JTA, various years).

Notes: Rates are compounded annually for the changes from 1979-81 average to 1987-89 average. Import values are evaluated at c.i.f. prices. Import prices are c.i.f. prices in Japanese yen adjusted by import tariff rates. China is mainland China.

commodities such as prepared bamboo shoots and both types of ginger, even the direction of price changes by supplier. This may occur because horticultural products are not homogeneous: varieties and production seasons vary from country to country. Therefore, it is important to distinguish horticultural imports not only by commodity but also by source of supply of each commodity.

For fruit imports the differences in growth rates among suppliers are also recognizable. For bananas and avocados, growth rates in value are similar among suppliers. However, the growth rate in quantity and changes in price differ for both commodities. Therefore, the similarity in growth of value among suppliers of bananas and avocados is not the result of similarity in Japan's import behavior.

The price of each trade flow may be determined independently of other trade flows and has to be examined individually, as Table 9 shows. Also the degree of differentiation and substitutability among trade flows varies by commodity and needs to be examined empirically. In the next chapter, a model that deals with trade flows differentiated by source of supply is presented, which is the basis of the following empirical analysis.

3

A MODEL OF IMPORT DEMAND FOR TRADE FLOWS

A Two-Stage Budgeting Theory

In the previous chapter it was observed that there are differences in Japan's import behavior not only among commodities but also among sources of supply of each commodity. This leads to a presumption that consumers differentiate between horticultural commodities by place of production. In dealing with Japan's import demand for horticultural products, therefore, it seems appropriate to adopt as a theoretical framework a two-stage budgeting procedure in which products are distinguished by their place of production and are not considered perfect substitutes for each other.

In general, for this procedure, it is assumed that consumers allocate their total expenditure in two stages. In the first stage, consumers allocate expenditure over broad groups of goods; in the second stage, the expenditure of each group is allocated to individual goods. The necessary and sufficient condition for the second-stage budget allocation is that the goods in a group are weakly separable from goods in any other group in consumer's utility function (see, for example, Strotz 1957; Pearce 1961; and Barten 1977).[6]

A consumer determines in the first stage the amount he or she wishes to spend on each group among m groups of goods so as to maximize utility,

$$U = U(Q_1, \ldots, Q_m), \tag{1}$$

subject to

$$Y = \sum_{i=1}^{m} Q_i P_i, \tag{2}$$

where U is the total utility of the consumer, Y is total expenditure, Q_i is the quantity index, and P_i the price index of group i, expressed as a function of quantities or prices of individual goods in group i:

$$Q_i = Q_i(q_{i1}, \ldots, q_{in}) \text{ and} \tag{3}$$

$$P_i = P_i(p_{i1}, \ldots, p_{in}), \tag{4}$$

where *in* is the number of goods in group i.

[6]Weak separability in utility function means that the marginal rate of substitution between two goods from the same group is independent of the consumption of goods in other groups.

The first-stage demand for group i, Q_i^*, resulting from the first-stage expenditure allocation, is expressed as a function of the group price indices and total expenditure,

$$Q_i^* = Q_i^* (P_1, \ldots, P_m, Y) \tag{5}$$

The second-stage demands for individual goods in each group are determined, minimizing the cost to realize the first-stage demand level, Q_i^*, and expressed as a function of individual prices in the group and Q_i^*.

$$q_{ij}^* = q_{ij}^* (p_{i1}, \ldots, p_{in}, Q_i^*), \tag{6}$$

where Q_{ij}^* is the demand for good j in group i.

In the context of a trade allocation model, imports of a particular commodity are assumed to be weakly separable from any other good, including domestic products of the same commodity. In the first stage, the expenditure on imports of a commodity—mango, for example—is determined. Then the expenditure is allocated over individual import products from different countries, say mangoes from the Philippines, mangoes from Mexico, and so on, in the second stage. Therefore, the demand for each trade flow of a commodity can be expressed as a function of the individual import price by supplier of the commodity and the quantity index, which is determined in the first-stage budget allocation.

Import Demand Specification

To empirically analyze the horticultural imports of Japan, the import demand for each trade flow of a commodity in the second-stage is specified in a double-logarithmic form:

$$\ln M_i = \alpha_i + \sum_{j=1}^{n} \beta_{ij} \ln(PM_j/PM) + \gamma_i \ln(E/PM), \tag{7}$$

where M_i is the quantity imported from country i, PM_j is the price of imports from country j, E is the total expenditure on all imports of this commodity, and PM is Stone's geometric price index for imports of this commodity.

$$\ln PM = \sum_{j=1}^{n} w_k \ln PM_k \tag{8}$$

where w_k is the value share of country k in total imports.[7]

This model is homogeneous to degree zero in all the import prices and the total import expenditure. However, it is known that the theoretical restrictions of symmetry and adding-up in consumer behavior cannot generally be imposed on the double-log specification of the demand system (Deaton and Muellbauer 1980). It is desirable that the second-stage import demand equations are specified in a complete demand system such as the Almost Ideal Demand System, the Translog, or the

[7]Note that in the specification of equations (7) and (8), a subscript representing a commodity is omitted and that the subscript i here refers to a source of imports.

Rotterdam models. However, when these models were applied to the trade flows of horticultural imports in Japan, preliminary examinations indicated that they did not result in statistically significant estimates of parameters. The double-log specification is a compromise with the reality that Japan's horticultural import performance not only reflects consumers' behavior, but also results from business activities of traders, who may not directly reflect consumers' preferences in their import businesses.[8] Moreover, the double-log specification makes it easier to manipulate the estimated coefficients in the growth-accounting analysis later in this report.

In the family of two-stage budgeting procedures, the most popular specification of the second-stage import demand is the Armington model (Armington 1969), which is often found in the agricultural trade literature (see, for example, Babula 1987; Grennes, Johnson, and Thursby 1977; Haniotis 1990; Ito, Peterson, and Chen 1988; Penson and Babula 1988; and Sarris 1983). The Armington model simplifies the second-stage import demand and summarizes it in a single parameter to be estimated, the elasticity of substitution among trade flows. Armington (1969) specifies the quantity index in equation (3) in the consumer's utility function as a constant elasticity of substitution (CES) form.[9]

$$Q = \left(\sum_{j=1}^{n} b_i q_i^{-\rho} \right)^{-1/\rho} \tag{9}$$

where Q is the quantity index of imports of a commodity, q_i is the import quantity from country i, and ρ is the parameter for the elasticity of substitution among the trade flows. Then the second-stage demands for individual trade flows are derived as follows:

$$q_i^* = b_i^{\sigma} Q (p_i/P)^{-\sigma} \tag{10}$$

where q_i^* is the demand for imports from country i, p_i is the price of imports from country i, P is the price index of import prices from all countries, and σ is the elasticity of substitution $[1/(1 + \rho)]$.

When equation (10) is expressed in logarithms and compared with equation (7), it appears that Armington's model, equation (10), is nested within the double-log model equation (7) for further restrictions on the parameters in the second-stage specification.[10] The restrictions are

- separability of each trade flow from other trade flows, even for imports of the same commodity, implying that only the own-price and group price indices are included as prices ($\beta_{ij} = 0$ for all $j \neq i$),
- homotheticity of trade flows on total expenditure on imports, implying that the import expenditure elasticity of any trade flow is unity ($\gamma_i = 1$ for all i), and

[8]Therefore, the coefficients to be estimated are considered composite characteristics of Japan's import performance rather than characteristics of pure consumer demand.

[9]In the following expressions, the subscript representing a commodity is omitted.

[10]Although Armington used a CES price index for P in equation (10), his model expressed in percent changes uses an alternative form to first differentiate the logarithmic price index in equation (8).

- equality of the own-price coefficient for all the trade flows in the same commodity ($\beta_{ii} = \beta_{jj}$ for all i and j countries).

These restrictions make the model simple and tractable.[11] For example, all the cross-price elasticities between trade flows are calculated from the single elasticity of substitution and trade shares. Ease of use and flexibility are the reasons for the popularity of Armington's model in international agricultural trade research. However, such assumptions for simplification must be tested for validity before being applied.[12] Testing Armington's assumptions is particularly important for international trade modeling and computable general equilibrium (CGE) modeling (Alston et al. 1990). The double-log specification of equation (7) can be used to test easily and directly the Armington assumptions.

In connection with the trade-flow equations in the second stage, the first-stage demand equation for total imports of a commodity is specified in the following manner:

$$\ln M = \delta_0 + \delta_1 \ln (PM/PI) + \delta_2 \ln (PA/PI) + \delta_3 \ln (Y/PI) \qquad (11)$$

where M is the total import quantity index for a commodity appearing in the trade-flow equation (7), expressed as the expenditure on the total imports (E), divided by the price index of the imports (PM); PA is the price of substitutes for the imports; PI is the consumer price index of the importing country; and Y is the income of the importing country.[13]

Statistical Estimation and Data

To estimate statistically trade-flow equations and first-stage demand equations, an error term is added to equations (7) and (11). For trade-flow equations, the error term is assumed to have expectation zero and to be correlated with errors of other trade-flow equations in imports of the same commodity. For the latter, it is assumed that contemporaneous correlations among errors of the same commodity trade flows are reasonable because some disturbances, which are not captured by variables in the model, take place with regard to a specific commodity and their effects are considered common to all the trade flows of that commodity. Therefore, it is appropriate that trade-flow equations are estimated as a set by commodity. For this purpose, iterative techniques for seemingly unrelated regressions (SUR) devised by Zellner (1962) are used.

In SUR procedure, first, the covariance matrix of errors in the system is estimated, applying the ordinary least square (OLS) method to each equation in the system; then the covariance matrix is used to estimate the system's parameters, applying the generalized least-square method. The procedure is iterated, recomput-

[11]Under these restrictions, the system of import demand satisfies the symmetry and adding-up conditions.

[12]Armington's assumptions were also examined theoretically by Winters (1984).

[13]Equation (11) is equivalent to the expenditure equation on total imports of the commodity if lnPM is added on both sides of the equation.

ing the covariance matrix with each new set of estimates until a convergence criterion is met.

In cases where the first-order autocorrelation in errors is found in the early stage regressions in SUR procedure, the variables in the system are replaced by their first-order transforms in SUR estimation, using the method developed by Berndt and Savin (1975). Namely, if X_t is the original variable, it is replaced by $X_t - \rho X_{t-1}$ in SUR procedure, where ρ is the autocorrelation parameter.

For the first-stage import demand equations, the error term is assumed to have expectation zero and to be neither temporally nor contemporaneously correlated. Therefore, the first-stage import demand equations are estimated separately, using the OLS method, but corrected for first-order serially correlated errors if necessary.

In case there are structural changes in the first-stage import demand equations for a part of the estimation period, dummy variables are introduced that correspond to each explanatory variable in equation (11) for the period in which the demand structure is supposed to be changed; and these are tested for joint significance using Chow's test.[14] The dummies are constructed to take the values of each explanatory variable, including the constant term for the period of structural changes, and to take zero value otherwise. Thus, the parameter for the period of structural changes is obtained for each explanatory variable by adding the coefficient of the dummy to the coefficient of the corresponding original variable. To find the period of structural changes, Chow's test for joint significance of dummies is iterated, changing the period for dummies by annual increments; the period that shows the largest F-value is chosen as the period of structural changes, provided it is statistically significant. This procedure is necessary in an econometric analysis that uses time-series data of a country such as Japan, which has experienced rapid socioeconomic changes in a short period of time.

The data necessary for trade-flow equations are import quantity and price data by trade flow. Trade data for import quantity and value by commodity and country of origin are available from the Japan Tariff Association, *Nihon Boeki Geppyo* (Japan Exports and Imports: Commodity by Country). Import prices are calculated by dividing import value by import quantity and adjusting by tariff rates that are obtained from the Japan Tariff Association, *Jikko Kanzeivitsu Hyo* (Customs Tariff Schedules of Japan).

In addition to trade data, the first-stage import demand equations require data on prices of import substitutes and income and consumer price indices of the importing country (Japan). To determine the prices of substitutes, the consumer cut-flower price index, the consumer vegetable price index, and the consumer fruit price index are used. In addition, domestic market prices of onions and kiwifruit are introduced in the equations for those commodities, to take into account competition with domestic products of the same commodity; domestic production of onions and kiwifruit is substantial. Pickled and nonpickled ginger are close though not perfect substitutes, so the import price of pickled ginger is added to the equation for nonpickled ginger and vice versa.

[14]Trade-flow equations are also subject to the test for structural changes. In the preliminary analysis, however, there were no significant structural changes discovered in any set of trade-flow equations.

All the domestic prices and price indices for Japan are obtained from the *Shohisha Bukka Shisu Nenpo* (Annual Report on the Consumer Price Index)(Japan Management and Coordination Agency, various issues). National income and population data are taken from *International Financial Statistics* (International Monetary Fund, various issues), and population data are used to define all the equations on a per capita basis to eliminate the effect of population growth. The estimation period differs by commodity depending on data availability.

4

EMPIRICAL RESULTS

Based on the model developed in the previous chapter, statistical estimations are conducted and reported in this chapter. The detailed results are presented in the Appendix, Tables 29-31 for the first-stage import demand equations and in Tables 32-39 for the trade-flow equations.[15]

In the estimation of first-stage import demand equations, Chow's test rejects structural stability for six commodities that show significant differences for a part of the estimation period. Therefore, dummy variables are introduced for those commodities, but only dummies that are statistically significant are included in the final estimation. Elimination of irrelevant variables increases the statistical efficiency of the coefficients of other variables (Pindyck and Rubinfeld 1981). For the same reason, those cross-price coefficients in trade-flow equations that are not statistically different from zero are eliminated in the final estimation.[16] This means that among the Armington assumptions, the separability of each trade flow from other trade flows in the same commodity is examined a priori. In this chapter, main results of estimations are used to characterize Japan's import demand for horticultural products.

First-Stage Import Demand

First, characteristics of Japan's horticultural import demand on a commodity basis are examined using the results of first-stage import demand equations. Table 10 summarizes import price and income elasticities of the first-stage import demand, which are interpreted in the same manner as conventional price and income elasticities by commodity. It may be convenient to discuss the characteristics of demand by cut flowers, vegetables, and fruits separately.

Cut-flower Imports

Among horticultural commodities, cut flowers are a major commodity, having grown rapidly in Japan's market. The import price and income elasticities of cut flowers in Table 10 are very large and statistically highly significant. This means

[15]In the preliminary regressions, a lagged independent variable, a time trend variable, and a slope dummy for the trade flow equations for cut flowers and bananas were examined. Some were not statistically significant and others were not even consistent with the demand theory. The specifications adopted in the regressions, reported in the Appendix Tables 29-39, are based on those preliminary regression results.

[16]The critical value of t-distribution used for eliminating variables is 1.00. That is, those dummy and cross-price coefficients whose t-values are less than 1.00 are excluded.

Table 10—Estimated import price and income elasticities of first-stage demand for Japan's imports of selected horticultural commodities

Commodity	Import Price Elasticity (δ_1)	Income Elasticity (δ_3)
Cut flowers	-2.134**	2.303**
Vegetables		
Onions	0.313	-0.441[a]
Green beans	0.022	0.368*
Bamboo shoots, dried	-0.070	-0.211[a]
Bamboo shoots, canned	-0.752*	2.523**
Ginger, nonpickled	-1.720**	2.659
Ginger, pickled	-0.020	2.116**
Fruits		
Bananas	-0.557**[a]	-0.389[a]
Mangoes	-1.038**	3.546**
Avocados	-1.648**	0.994
Kiwifruit	-2.746**	1.765
Pineapple, fresh	-0.669*[a]	-0.129
Pineapple, frozen	-0.479[a]	-1.019[a]
Pineapple, canned	-0.007[a]	1.219*

Source: Results of regressions in the Appendix, Tables 29-31.
[a]These numbers are estimates for the period after structural changes.
*Significant at the .05 level.
**Significant at the .01 level.

that cut-flower imports are extremely sensitive to price and income changes and considered a luxury good in the sense that the demand increases faster than per capita income goes up.

In describing the Japanese demand for cut flowers, it is useful to consider consumption of cut flowers in three ways: flowers for commercial use, flowers for use in floral arrangements *(ikebana)*, and flowers for retail sales to individuals. Traditionally, imported flowers have mainly served commercial uses, such as banquets, weddings, funerals, and other ceremonies, because their prices are low and there is no need for the flowers to last a long time. In recent years, however, the demand for flowers as personal gifts has grown rapidly, and imported flowers have become common in flower shops. This corresponds to the fact that annual household expenditure on cut flowers increased 1.5 times from Y6,289 in 1980 to Y9,765 in 1989.

There are a number of reasons why individual Japanese are opting to give flowers as gifts. First, as the Japanese become more affluent, the desire to enjoy that affluence becomes more tangible. Second, amidst a profusion of material goods, sending flowers as a gift seems to express one's feelings more effectively. Third, the physical distribution system has become well established, with home-delivery service widely available, making it possible for people to order flowers with confidence (JETRO 1990, p.16). Imported flowers, which offer a wide range of choices, are benefiting from this expanding market.

Vegetable Imports

Vegetables selected in this report are limited to relatively traditional ones due to lack of data. As seen in Table 10, onions and green beans did not show the expected sign of import price elasticity, though neither is statistically significant.[17] For onions, this insensitivity to import price results from the role of imports in the domestic market. Onions are imported when domestic onions are in short supply and the domestic price soars because the commercial demand for onions for restaurants and for processed food industry uses is fixed. Then onion imports are increased by traders who speculate in onions even when prices abroad are the same or higher than normal years. Examples are sudden increases in onion imports from 77,000 tons in 1980 to 205,000 tons in 1981 and from 67,000 tons in 1983 to 158,000 tons in 1984. In the Appendix, Table 29, the detailed estimation results of onion imports indicate a large and highly significant coefficient of the domestic onion price variable. Therefore, the domestic market price is the dominant factor in the determination of onion imports.

The figures for bamboo shoots in Table 10 show quite different demand characteristics for dried and canned bamboo shoots. Whereas dried bamboo shoots have little sensitivity to either price or income changes, canned bamboo shoots are sensitive to both, especially to income changes. Dried bamboo shoots are called *menma* and are mostly used in soups, typically in noodle soups, whereas canned bamboo shoots are widely used in Japanese and Chinese cooking. Recent increases in demand for canned bamboo shoots are attributed partly to the increases in use by take-out lunch shops whose businesses have been rapidly growing.

Pickled and nonpickled ginger also have different characteristics and uses. Ginger is classified as a spice in trade statistics, rather than a vegetable, because it is commonly used for eliminating strong odors from meat or fish and also for flavoring soups and other dishes. Nonpickled ginger is used for this purpose, and import demand for this type of ginger is very price sensitive, having an import price elasticity of 1.72 (Table 10). In Japan, however, ginger is considered a vegetable because it is usually consumed as thinly sliced pickled ginger, which is served with *sushi*. The income elasticity for pickled ginger is large and stable because the demand for *sushi* increases as per capita income goes up; *sushi* is still a luxury good in Japan. Pickled ginger is also commonly used in Japanese take-out lunches called *bento*. The supplementary character of pickled ginger explains why it is sensitive to import price changes.

Fruit Imports

Imported fruits can be classified into two groups according to their demand characteristics. One group—bananas and the three types of pineapple—are traditional tropical fruits, demand for which is not very sensitive to either price or income changes. The other group consists of mangoes, avocados, and kiwifruit, which are relatively new fruits for Japanese consumers and characterized by large price and income elasticities.

[17]Imported green beans are mostly black *matpes* and consumed in the form of bean sprouts.

Bananas are the most important imported fruit in volume. Bananas used to be a luxury for most Japanese, but since importation of bananas was liberalized in 1963, large supplies have become available at cheaper prices. In the late 1960s, multinational fruit corporations invested in banana plantations in the Philippines, targeting the Japanese market. Now, consumption of bananas seems to have reached the satiation point, as evidenced by a nonsignificant income elasticity in Table 10, although the demand is fairly price sensitive and highly significant.

Pineapple is similar to bananas, but canned pineapple are somewhat different from other types of pineapple. Canned pineapple is less sensitive to price but more sensitive to income changes than fresh and frozen pineapple. The price elasticity of canned pineapple is not significant mostly because imports of canned pineapple were restricted by import quotas until April 1990 when the import quota system for canned pineapple was abolished. Therefore, the quantity imported was bound by the quota and did not reveal the true demand, which resulted in an insensitivity of imports to price changes. The high income elasticity of canned pineapple is supported by a strong demand for use in cooking in family restaurants and take-out lunch shops.

In response to the removal of import quotas on canned pineapple, the demand for frozen pineapple is likely to shrink, because in the past frozen pineapple was imported and repacked in cans domestically, in order to meet the demand for canned pineapple over and above the quota. Such an incentive no longer exists.

Among the new fruits—mangoes, avocados, and kiwifruit—Japan's imports of all three are growing rapidly; the price elasticity of kiwifruit and the income elasticity of mangoes are remarkably large with high statistical significance. Although kiwifruit are not produced in developing countries at this time, the growth of kiwifruit consumption in Japan's market has many lessons for them. As shown in Table 7, imports of kiwifruit have increased by 37 percent per year for the last decade, a higher growth rate than any other fruit covered by trade statistics. The success has been based on a remarkable price decline of 15 percent annually for a decade. This high rate of price decline is not directly linked to recent appreciations of the Japanese yen, because New Zealand, the almost exclusive supplier of kiwifruit to Japan, offers prices in Japanese yen on kiwifruit trade contracts rather than in U.S. dollars. In point, New Zealand has reduced the price of kiwifruit and assumed the risk of exchange rate changes, thus making it easy for Japanese importers to expand imports steadily.[18]

The import demand for avocados also has been supported by price declines. Import prices of avocados from Mexico and the United States declined annually by 11 and 7 percent, respectively, during the last decade.

Mangoes, another major new commodity in horticultural imports in Japan, have the largest income elasticity among the commodities listed in Table 10. Mangoes are considered an exotic and luxurious commodity, as bananas used to be in Japan. Bananas are no longer used in fruit baskets for personal gifts, but mangoes are popular. The potential demand for mangoes is expected to be very large.

[18]As the Japanese yen appreciates, New Zealand benefits from contracts based on the yen. But even when the yen depreciated in the early 1980s, the import price of kiwifruit in yen declined.

Trade-Flow Equations

The characteristics of Japan's import demand described for each commodity are not shared equally by all of the trade flows of that commodity. Estimated own-price coefficients and estimated import expenditure coefficients are summarized in Table 11, based on the detailed results of estimated trade-flow equations in the Appendix, Tables 32-39. Results are again discussed by commodity groups.

Cut-flower Trade Flows

Major suppliers of cut flowers to Japan are Taiwan, Thailand, and the Netherlands. The estimated coefficients of the three trade-flow equations for these suppliers of cut flowers are all highly significant, but the magnitudes of both their own-price and import expenditure coefficients differ by trade flow (Table 11). The demand for cut flowers from the Netherlands is the most sensitive to price change, followed by Thailand and then Taiwan; imports from the Netherlands are also most sensitive to income changes, followed by Taiwan and Thailand in that order. The product differentiation model by country of origin adopted in this study seems very suitable for analyzing cut-flower imports to Japan, because each exporting country provides different kinds of cut flowers. Taiwan exports mainly chrysanthemums; Thailand concentrates its exports on orchids; and the Netherlands supplies various kinds of cut flowers, such as freesias, tulips, lilies, roses, and carnations. The differences in magnitude of estimated coefficients by trade flow reflect differences in consumers' preferences for the various kinds of cut flowers. The statistical results indicate that cut-flower imports are "well-behaved" in the theoretical framework of product differentiation, with reasonable and stable estimates.

The trade-flow equations for cut flowers in Appendix Table 32 include a dummy variable. This was done to capture the effect of sales promotions by the Netherlands, which opened a Tokyo office in 1985. Their activities include advice to florists on new varieties, demonstrations of different ways of arranging them, and other services, which have stimulated the demand for Dutch flowers. Another factor favoring Dutch flowers is preshipment inspection of cut flowers so that they meet Japan's plant regulations, which the Netherlands started in late 1985, with Japanese quarantine officers dispatched to Amsterdam at the Netherlands' cost. Preshipment inspection simplifies quarantine procedures and reduces the risk of exports being rejected on arrival at Japan's airports. The effects of such promotional activities are captured by the introduction of a dummy variable set at a value of one for 1986-89 and zero otherwise in each trade-flow equation for cut flowers. The results indicate that the Netherlands gained significantly from such sales promotions by shifting Japan's import demand toward Dutch flowers and away from Taiwan, the major loser.

Vegetable Trade Flows

Although on a commodity basis import price elasticities were small, except for pickled ginger, many estimated own-price coefficients of vegetable trade flows show great sensitivity to relative price changes. Of 14 trade flows in vegetables, 9 have highly significant own-price coefficients at a 1 percent level. However, onions from Taiwan do not satisfy the sign conditions of the own-price coefficient.

Table 11—Estimated own-price and income expenditure coefficients of trade-flow equations for Japan's imports of cut flowers, selected vegetables, and fruits

Commodity/ Country of Origin	Own Price Coefficient (β_{ii})	Import Expenditure Coefficient (γ_i)
Cut flowers		
Taiwan	-1.337**	1.322**
Thailand	-1.650**	1.032**
Netherlands	-2.743**	1.624**
Vegetables		
Onions		
Taiwan	0.679	0.259*
United States	-2.191**	1.165**
New Zealand	-1.292	1.781**
Green beans		
Thailand	-2.053**	1.070**
Bamboo shoots, dried		
Taiwan	-2.755**	1.027**
China	-0.705	0.603
Bamboo shoots, canned		
Taiwan	-2.673**	-0.036
Thailand	-8.546**	3.071*
China	-2.090**	2.449**
Ginger, nonpickled		
Taiwan	-1.558**	1.753**
Thailand	-1.648	0.874*
China	-1.160**	0.054
Ginger, pickled		
Taiwan	-7.897**	0.731*
Thailand	-1.022	3.141**
Fruits		
Bananas		
Taiwan	-2.029**	1.603**
Philippines	-4.448	-0.765
Mangoes		
Philippines	-1.931**	0.588**
Mexico	-2.434**	1.924**
Avocados		
Mexico	-2.014**	0.662**
United States	-0.354	1.077**
Kiwifruit		
New Zealand	0.052	1.086**
Pineapple, fresh		
Taiwan	-0.365	2.115**
Philippines	-5.332**	1.777**
Pineapple, frozen		
Taiwan	-0.842	0.227
Thailand	-4.096**	2.908**
Pineapple, canned		
Taiwan	-4.317**	1.349**
Thailand	-0.700	1.013**
Philippines	-0.902	0.918**

Source: Results of regressions in the Appendix, Tables 32-39.
*Significant at the .05 level.
**Significant at the .01 level.

This irrational import behavior of onions from Taiwan may be partly attributed to the import cartel permitted in 1966 under the Export and Import Transaction Laws of the Japan Vegetable Importers Union to combat the monopolized exporting system in Taiwan. Under the cartel, quotas on onion imports from Taiwan were assigned. The import cartel, however, was abolished in 1987.

The sizes of own-price coefficients differ by source of supply in each set of trade flows. The own-price coefficients of Thailand in canned bamboo shoots and Taiwan in pickled ginger are exceptionally large, but other own-price coefficients are in a range between -0.7 and -2.8, excluding onions from Taiwan, as mentioned before. Thailand increased its exports of canned bamboo shoots through relative price declines that took advantage of this large own-price coefficient of import demand, while Taiwan, which used to be the dominant supplier of canned bamboo shoots, lost its market share quickly due to relative price increases in the late 1980s. The observed differences in own-price coefficients by trade flow justify the assumption that consumers distinguish vegetable products by place of production, even though the products are called by a common commodity name.

These findings, combined with the result of import price elasticities in Table 10, indicate that, although vegetable imports are relatively insensitive to price changes on a commodity basis, once the total amount to be spent for imports of a vegetable is determined, then the Japanese seek cheaper products so that price competition among suppliers is inevitable.

The differences by country of origin are also observed in the coefficients of the import expenditure variable. If the import expenditure coefficient is unity (one), demand for that trade flow is homothetic, and it expands at the same rate as total imports of the commodity. In other words, the market share of the trade flow does not change unless relative prices change in homothetic demand. If the estimated coefficient of the import expenditure variable is significantly greater than unity, it is a good indication for an exporting country that its exports can expand more than others and its share increase as Japan's market grows. But if the coefficient is significantly less than unity, the exporter cannot enjoy expansion of exports for that trade flow commensurate with the growth of Japan's market.

Among the vegetable trade flows, canned bamboo shoots from Thailand and China and pickled ginger from Thailand have relatively large estimates of the import expenditure coefficient, while the estimates for canned bamboo shoots from Taiwan and for nonpickled ginger from China are very small. However, it must be statistically tested to judge if the coefficient is significantly greater or smaller than unity. This can be done with a chi-square test and will be examined later, together with Armington's assumptions.

Fruit Trade Flows

Table 11 also summarizes the estimated own-price and import expenditure coefficients of fruit trade flows. On the own-price coefficients, each commodity has at least one trade flow that shows a significantly larger coefficient than others. Exceptions are mangoes, whose trade flows have similar own-price coefficients, and kiwifruit, for which New Zealand dominates the trade flows, so that the own-price of New Zealand kiwifruit relative to the total import price does not fluctuate enough, resulting in an insignificant own-price coefficient.

The sharp contrast of own-price coefficients in the same commodity reflects the dynamic aspect of Japan's fruit trade, in which particular trade flows rise and fall in price competition. One example is the rapid expansion in the mid-1970s of exports of bananas and fresh pineapple from the Philippines to Japan, after investments in Philippine plantations by multinational corporations enabled the Philippines to offer cheaper prices than other suppliers. In frozen pineapple, the sharp increase in share that Thailand experienced in the 1970s also resulted from price competition among suppliers.

In contrast to these success stories, canned pineapple from Taiwan has experienced a decline. Taiwan used to be a major supplier of canned pineapple to Japan, enjoying a large market share until the early 1970s. But in the course of its rapid economic growth as one of the Newly Industrializing Economies, Taiwan lost its comparative advantage in labor-intensive industries such as the canning industry due to increasing labor costs.[19] Appreciation of the new Taiwan dollar against the U.S. dollar of more than 40 percent between 1986 and 1989 also hurt exporting industries in Taiwan and priced products out of many foreign markets.

Estimated coefficients of import expenditure variables in fruit trade flows also show wide variations. Among the large coefficients, those of bananas and fresh pineapple from Taiwan deserve attention. Japanese consumers consider Taiwan bananas to be of higher quality because the shorter transporting distance means less spoilage and because the variety grown in Taiwan is sweeter than that grown in the Philippines. As a result, Taiwan bananas are priced higher than Philippine bananas in the market. This may partly explain the differences in their coefficients. The large import expenditure coefficient of fresh pineapple from Taiwan is partly attributed to recent increases in imports of a new variety, Tainung No. 4, which has gained popularity because of its high sugar content and because its skin is easily peeled so that it can be picked apart with fingers and eaten without cutting.

The import expenditure coefficient of frozen pineapple from Thailand shows the largest value among the fruit trade flows in the study, reflecting a quick shift of Japan's source of imports from Taiwan to Thailand in the early 1980s, which cannot be explained by price competition. This happened partly because importers expected Taiwan to lose competitiveness with rapid increases in its wage rate. Mangoes also indicate a substantial difference in the import expenditure coefficient between the Philippines and Mexico. One reason for this is a difference in the variety of mangoes grown in the two countries: mangoes from the Philippines are mostly pelican mangoes, which are not as sweet as the apple mangoes grown in Mexico. All the estimated coefficients of the import expenditure variable are subject to the statistical test for homotheticity, which will be conducted in the next section.

[19]Taiwan was also driven out of the market by relative price increases in canned bamboo shoots for the same reason. Production of fresh vegetables and fruits is also labor-intensive, but response may lag behind wage increases because farmers may not explicitly take into account their own-labor cost in production costs, and farm labor may not be easily relocated to nonfarm uses. This partly explains why some of the estimated price elasticities for fresh vegetables and fruits are less than those of canned bamboo shoots from Taiwan.

Meanwhile, trade-flow equations for banana imports in the Appendix Table 37 include a dummy variable to represent the effects of sales promotions by the multinational fruit corporations, such as Polly Peck International, Castle and Cook, and United Brands, which have developed massive sales promotions for their respective brand names, Del Monte, Dole, and Chiquita, to penetrate the Japanese market. In this attempt to capture the effects on trade flows of the promotion activities, the dummy variable takes a value of one for 1969-89 and zero otherwise. The statistical results imply that the sales promotions allowed the Philippines to export more bananas to Japan than they would have without the promotions. Taiwan suffered a loss of market share in Japan.

Statistical Tests

The estimated coefficients for trade flows are subjected to statistical tests that serve several purposes. First, the coefficients of the import expenditure variable are tested against the homotheticity hypothesis for individual trade flows. If the import expenditure coefficient of a trade flow is greater than unity, the exporter of the trade flow gains by growth in Japan's market for imports of that commodity. On the other hand, those exporters who have import expenditure coefficients less than unity cannot take advantage of Japan's market growth.

To determine if a coefficient is significantly different from unity, chi-square tests are used against the hypothesis $H_o : \gamma \leq 1$ for those with estimated coefficients greater than one, or against the hypothesis, $H_o : \gamma \geq 1$ for those with estimated coefficients less than one. The results are summarized in Table 12. Of the 31 trade flows under study, 13 show import expenditure coefficients significantly greater than unity; these are called "market-favored" trade flows. Six trade flows appear to have coefficients significantly less than unity, and these are called "market-disfavored." The coefficients of the 12 remaining trade flows are not significantly different from unity, and thus are called "market-neutral."

It is worth noting that all the trade flows from Thailand and developed countries are classified as market-favored or market-neutral, meaning that all trade flows from those countries benefit from Japan's market growth. Trade flows from Taiwan, the Philippines, Mexico, and China are split into three groups, depending on commodity. The differences in the magnitudes of the import expenditure coefficients are compounded results from differences in product quality, consumers' preferences, business partnerships, political alliances, and other factors. To identify the real reasons behind these differences, a more detailed study by trade flow is required.

In the following statistical tests, Armington assumptions are examined. As discussed in Chapter 3, the Armington model is a nested model within the double-log specification imposing restrictions of separability (β_{ij} = for all $j \neq i$), homotheticity ($\gamma_i = 1$ for all i), and equality of own-price coefficients ($\beta_{ii} = \beta_{jj}$ for all i and j) on the system jointly. Among the assumptions, separability is examined a priori in the process of trade-flow equation estimations. It is not rejected for green beans, pickled ginger, bananas, mangoes, kiwifruit, and fresh pineapple. Therefore, the cross-price coefficients in trade flows of those commodities are set at zero in the final estimation.

Table 12—Results of the chi-square test for homotheticity of individual trade flows with the estimates of the import expenditure coefficient (γ_i)

Commodity	$\gamma_i > 1$[a]	$\gamma_i = 1$[b]	$\gamma_i < 1$[c]
Cut flowers	Taiwan Netherlands	Thailand	...
Vegetables			
Onions	New Zealand	United States	Taiwan
Green beans	...	Thailand	...
Bamboo shoots, dried	...	Taiwan China	...
Bamboo shoots, canned	China	Thailand	Taiwan
Ginger, nonpickled	Taiwan	Thailand	China
Ginger, pickled	Thailand	Taiwan	...
Fruits			
Bananas	Taiwan	...	Philippines
Mangoes	Mexico	...	Philippines
Avocados	United States	...	Mexico
Kiwifruit	New Zealand	...	...
Pineapple, fresh	Taiwan Philippines	...	...
Pineapple, frozen	Thailand	Taiwan	...
Pineapple, canned	...	Taiwan Thailand Philippines	...

Note: H_o is the null hypothesis and γ_i is the import expenditure coefficient.
[a]Trade flows that rejected the null hypothesis H_o: $\gamma_i \leq 1$ at the 10 percent level.
[b]Trade flows that did *not* reject H_o: $\gamma_i = 1$ at the 10 percent level.
[c]Trade flows that rejected H_o: $\gamma_i \geq 1$ at the 10 percent level.

The results of testing homotheticity, equality, and all Armington assumptions jointly on the final estimates (given in the Appendix, Tables 32-39) are summarized in Table 13. Chi-square test statistics show that individual assumptions are not rejected at the 10 percent level of significance in four cases (green beans, dried bamboo shoots, avocados, and canned pineapple) against homotheticity of all import expenditure coefficients, and they are not rejected against equality of all own-price coefficients in two cases (nonpickled ginger and bananas). However, full Armington restrictions are rejected in all 14 commodities in the study at the 10 percent significance level. The results imply that Armington's approach may not be appropriate for analysis of Japan's trade in the horticultural commodities selected, although the individual assumptions that were not rejected by the statistical tests can be used in modeling for those commodities.

Elasticities of Trade Flows

The coefficients estimated for first-stage import demand equations and for trade-flow equations can be combined to derive the elasticities of trade flows, which represent total effects of changes in explanatory variables on trade flows. By substituting the related first-stage import demand equations of a commodity into a trade-flow equation, followed by total differentiation, the own-price elasticity and income elasticity of the trade flow can be expressed as follows:

Table 13—Chi-square statistics for testing Armington assumptions in trade-flow equations

Commodity	Homotheticity $\gamma_i = 1$	Equality $\beta_{ii} = \beta_{jj}$	Armington $\beta_{ij} = 0, \beta_{ii} = \beta_{jj}, \gamma_i = 1$
Cut flowers	87.6	12.6	463.6
Vegetables			
Onions	44.3	10.0	78.7
Green beans	0.1*	...	...
Bamboo shoots, dried	0.6*	23.4	42.5
Bamboo shoots, canned	57.9	12.1	240.2
Ginger, nonpickled	105.2	1.3*	146.2
Ginger, pickled	38.7	20.2	45.1
Fruits			
Bananas	6.2	0.6*	6.3
Mangoes	12.3	6.2	20.9
Avocados	4.1*	6.2	8.4
Kiwifruit	22.9	...	...
Pineapple, fresh	22.8	18.3	47.1
Pineapple, frozen	24.5	5.4	50.1
Pineapple, canned	3.0*	7.3	38.1

Note: γ_i is the import expenditure coefficient and β_{ij} is the price coefficient.
*Chi-square statistics not significant at the 10 percent level.

$$\varepsilon_i = \beta_{ii} - w_i\left(\sum \beta_{ij} - \gamma_i\delta_1\right), \text{ and} \tag{12}$$

$$\eta_i = \gamma_i\delta_3, \tag{13}$$

where ε_i is the own-price elasticity and η_i is the income elasticity of demand for a trade flow from country i; w_i is the value share of country i in total imports; β, γ, and δ are the coefficients that appear in the trade-flow equations and the first-stage import demand equations.

The calculated own-price and income elasticities of trade flows based on equations (12) and (13), using the estimated coefficients and 1987-89 average value shares, are presented in Table 14. In the calculation, those coefficients that have wrong signs in the estimates are set at zero to avoid inconsistency. It is important for exporting countries to know the elasticities by trade flow in order to identify the characteristics that differentiate their products from others in the Japanese market.

The calculated own-price elasticities show impressively how price-sensitive Japan's demand is for individual trade flows. In Table 14, 20 trade flows out of a total of 31 have own-price elasticities valued greater than one in absolute value. Even among those elasticities that are less than one, six are greater than 0.5. These large own-price elasticities, particularly those greater than one, indicate that the exporting countries could not only increase the quantity of exports, but also their earnings from the exports by making an effort to lower prices by reducing the costs of production, marketing, and distribution. Large own-price elasticity is a general characteristic of horticultural commodities, but such a characteristic is not equally attached to all trade flows. Variations in the size of own-price elasticities by

Table 14—Calculated own-price and income elasticities of trade flows for selected horticultural products to Japan

Commodity/ Country of Origin	Own-Price Elasticity[a] (ε_i)	Income Elasticity (η_i)
Cut flowers		
Taiwan	-1.766	3.044
Thailand	-2.128	2.377
Netherlands	-2.952	3.741
Vegetables		
Onions		
Taiwan	-0.348	-0.114
United States	-1.373	-0.514
New Zealand	-1.339	-0.786
Green beans		
Thailand	-0.926	0.394
Bamboo shoots, dried		
Taiwan	-0.236	-0.217
China	-1.194	-0.127
Bamboo shoots, canned		
Taiwan	-2.181	-0.091
Thailand	-9.666	7.745
China	-1.930	6.178
Ginger, nonpickled		
Taiwan	-2.632	4.662
Thailand	-1.644	2.326
China	-0.691	0.143
Ginger, pickled		
Taiwan	-6.142	1.547
Thailand	-0.374	6.648
Fruits		
Bananas		
Taiwan	-1.876	-0.624
Philippines	-0.755	0.298
Mangoes		
Philippines	-0.974	2.085
Mexico	-2.324	6.822
Avocados		
Mexico	-1.809	0.659
United States	-1.804	1.070
Kiwifruit		
New Zealand	-2.850	1.918
Pineapple, fresh		
Taiwan	-0.459	-0.273
Philippines	-1.572	-0.229
Pineapple, frozen		
Taiwan	-0.840	-0.231
Thailand	-2.859	-2.966
Pineapple, canned		
Taiwan	-5.126	1.644
Thailand	-0.471	1.235
Philippines	-0.584	1.119

Note: Elasticities are calculated using estimated coefficients in the Appendix, Tables 29-39, and average value shares for 1987-89.

[a]For the import price and own price coefficients estimated with a positive sign, the value was set at zero.

commodity and also by trade flow are wide. That is, own-price elasticities are different for, say, canned bamboo shoots from Taiwan than they are for canned bamboo shoots from Thailand.

The calculated income elasticities are also widely scattered. Japan's economic growth, accompanied by higher per capita income, does not necessarily lead all trade flows to prosperity. The trade flows listed in Table 14 are classified into two groups according to the magnitude of their income elasticities. One group consists of 16 trade flows whose income elasticities are greater than one. This group can expand its exports as Japan's economy grows. In particular, the 10 trade flows of the 16 in this group that have income elasticities greater than two are very likely to continue to prosper. The most prosperous trade flows include those in cut flowers, canned bamboo shoots, ginger, and mangoes.

The income elasticities calculated by trade flow are naturally subject to the income elasticities for individual commodities as well. But some trade flows with relatively large income elasticities on a commodity basis do not enjoy the same demand growth as that commodity because the coefficient of import expenditure in trade-flow equations is small. Examples are canned bamboo shoots from Taiwan, nonpickled ginger from China, and avocados from Mexico.

The second group consists of 15 trade flows whose income elasticities are less than one, including the three trade flows mentioned. All the trade flows with low income elasticities are traditional horticultural commodities such as onions, green beans, dried bamboo shoots, bananas, and fresh and frozen pineapple. Reflecting some negative income elasticities on a commodity basis, 11 trade flows in this group have negative income elasticities. Although the negative values of trade-flow income elasticity are based on insignificant estimates of commodity income elasticities, trade flows in this group contrast with those in the first group. In other words, the spectrum of income elasticity indicates a kind of polarization of trade flows into those with very high income elasticities and others with very low or even negative income elasticities.

The differences in price and income elasticities by trade flow within the same commodity observed in some cases in Table 14 may include the effects of traders who developed new sources of imports and shifted their partners from one country to another, especially in the course of the recent appreciation of the yen. Most horticultural commodities are traded by relatively small traders, whose business is very volatile. Bananas and pineapple, which are produced and traded by multinational corporations, are the exception. As long as the small traders have freedom of exit and entry, they ensure the competitive nature of the market. The large price and income elasticities in Table 14 reflect such a market structure for horticultural imports into Japan.

5

ACCOUNTING FOR IMPORT GROWTH

The characteristics of Japan's import demand for horticultural products described in the previous chapter play important roles in the growth of imports. The factors that contributed the most to import growth are demand-side price and income changes. The coefficients estimated for first-stage import demand equations and for trade-flow equations can be used to evaluate the contributions of price and income factors to import growth; they can also indicate the size of the change in each price and income variable.

Accounting for Commodity Import Growth

First, the growth rates of commodity imports are examined. The import growth rate of a commodity, which is measured by the annual growth rate of the import quantity index defined for the first-stage import demand equations, is a result of changes in factors that appeared as explanatory variables in the equation. To identify the degree of change contributed by each factor, the growth rate of the import quantity index for a commodity is decomposed using the following growth-accounting equation derived from the first-stage import demand equation (11):

$$G(M) = \delta_1 G(PM/PI) + \delta_2 G(PA/PI) + \delta_3 G(Y/PI), \qquad (14)$$

where G denotes percent changes of the variable in parentheses [G(x) = dx/x]; M and PM are the commodity's import quantity and price indices; PA is the price of substitutes for the import; Y is income; PI is the consumer price index; and δ_1, δ_2, δ_3 are the parameters in the first-stage import demand equation. In other words, the contribution of each explanatory variable in the demand equation is the product of a percentage change of the variable by the coefficient in the demand equation.

The growth-accounting equation (14) is then applied to explain the growth of commodity imports between the 1979-81 average and that for 1987-89.[20] The results, summarized in Table 15, indicate that the model used in the analysis explains the import growth in the 1980s well; residuals are small compared with the realized growth rates for most commodities. Cut flowers, both types of ginger, and fresh pineapple, whose residuals are less than 10 percent of the realized growth rates, are explained especially well by the factors of import price, substitute price, and income changes. On the other hand, the residuals for green beans, bananas, and

[20]In growth accounting, those coefficients that have wrong signs in the estimates are set at zero to avoid inconsistency.

Table 15—Factors accounting for Japan's import growth in selected horticultural products, 1979-81 to 1987-89

Commodity	Import Growth Rate[a]	Contribution of Changes in			Total Contribution	Residual
		Import Price	Substitute Price[b]	Income		
			(percent)			
Cut flowers	17.63	7.02	6.48	5.87	19.36	-1.74
Vegetables						
Onions	-5.88	0.00[c]	-3.14	-1.12	-4.26	-1.62
Green beans	0.44	0.00[c]	0.05	0.94	0.99	-0.55
Bamboo shoots, dried	-1.18	-0.25	0.00[c]	-0.54	-0.79	-0.39
Bamboo shoots, canned	10.48	1.73	0.00[c]	6.43	8.16	2.32
Ginger, nonpickled	11.28	11.17	-6.54	6.78	11.41	-0.13
Ginger, pickled	4.39	0.04	-1.34	5.39	4.10	0.29
Fruits						
Bananas	-0.08	1.14	-0.42	-0.99	-0.27	0.20
Mangoes	19.46	6.87	-0.18	9.04	15.72	3.73
Avocados	22.45	15.58	0.00[c]	2.53	18.12	4.34
Kiwifruit	36.34	45.45	-21.20	4.50	28.74	7.60
Pineapple, fresh	1.95	2.59	-0.26	-0.33	2.00	-0.05
Pineapple, frozen	-0.31	3.74	-0.62	-2.60	0.52	-0.82
Pineapple, canned	1.21	0.06	-0.55	3.11	2.62	-1.41

Note: Growth-accounting is conducted for the changes from 1979-81 to 1987-89, using compounded annual growth rates of the following variables: import price, the price of substitutes, and income, all divided by the consumer price index.

[a]Based on annual growth rate of the per capita import quantity index for each commodity.

[b]The contribution of changes in alternative prices is included.

[c]The coefficient of the variable is set at zero because the estimate had the wrong sign.

frozen and canned pineapple are relatively large compared with the realized growth rates, which nevertheless are the lowest in Table 15.

For individual commodities, import price, substitute price, and income changes contribute almost equally to import growth in cut flowers. For other commodities, however, a single dominant factor contributes more to import growth than other factors. Import growth in six commodities is supported mainly by import price changes. The import growth rates of avocados, kiwifruit, and fresh pineapple are explained exclusively by import price changes. In vegetables, the contribution of import price changes to nonpickled ginger is remarkably large.

For another six commodities, Japan's income growth is the major factor explaining the import growth: canned bamboo shoots, pickled ginger, and mangoes have particularly large contributions from income growth. The import growth of onions is explained mainly by substitute price changes, that is by changes in the domestic market price of onions. The declines in onion imports from 1979-81 to 1987-89 can be attributed mainly to price declines in the domestic market.

Accounting for Trade-Flow Growth

The growth-accounting method can also be applied to the growth of trade flows. Combining the trade-flow equation (7) with the first-stage equation (11) in

the same manner as in elasticity derivation for trade flows, a growth rate of a trade flow is decomposed as follows:

$$G(M_i) = (\beta_{ii} - W_i B_i)G(PM_i) + \sum_{k \neq i}^{n}(\beta_{ik} - W_k B_i)G(PM_k)$$

$$+ \gamma_i\delta_2 G(PA) + \gamma_i\delta_3 G(Y) - \gamma_i(\delta_1 + \delta_2 + \delta_3)G(PI), \qquad (15)$$

where

$$B_i = \sum_{j=1}^{n}\beta_{ij} - \gamma_i\delta_1 ,$$

and G again denotes percent changes of the variable in parentheses following G. Thus, the import growth rate of a commodity from country i, $G(M_i)$, is the sum of contributions of own-price changes, $G(PM_i)$; competitor's price changes, $G(PM_k)$; substitute price changes, G(PA); Japan's income growth, G(Y); and Japan's inflation rate, G(PI), all multiplied by a related coefficient.[21]

The results of accounting for trade-flow growth between 1979-81 and 1987-89 are presented in Table 16 for cut flowers and vegetables and in Table 17 for fruits.[22] The contributions of price and income changes are compared with the realized growth rate of each trade flow that appeared in Table 9 in Chapter 2.[23]

Reflecting the large own-price elasticities that characterize most horticultural trade flows, many trade flows show substantial contributions of own-price changes to import growth; the contributions of own-price changes are shown in the diagonal elements in the price change blocks in Tables 16 and 17. Indeed, 19 trade flows out of 31 have own-price changes as the most important factor determining the import growth rate between 1979-81 and 1987-89. It is noteworthy that even trade flows of those commodities that showed small contributions of import price changes in Table 15 have large contributions from own-price changes. Examples are onions from the United States and New Zealand, bamboo shoots from China, and pickled ginger and canned pineapple from Taiwan.

The importance of price changes in trade-flow growth is extended to price changes in competitor's products. In some cases the contribution of competitor's price changes exceeds any contribution of other factors, whether of positive or negative value.[24] These cases include trade flows of onions, canned bamboo shoots, nonpickled ginger, bananas, and canned pineapple from Taiwan, as well as bamboo shoots from Thailand.

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[21]Coefficients of G are elasticities of the trade flow with respect to the variable in parentheses following G.

[22]Again, if the estimated coefficient has a wrong sign, the value is set at zero.

[23]The coefficients used in growth-accounting are based on the estimates of per capita trade-flow equations and per capita first-stage demand equations. Therefore, the total contribution is adjusted, including the population growth rate, to make it comparable to the realized trade-flow growth rate.

[24]The sign of contributions of competitor's price changes is not necessarily the same as the direction, because the effect of competitor's price changes on the import price index may exceed the substitution effect if the competitor's share is large, whereas the sign of contributions of own-price changes is always opposite to the direction of own-price changes.

Table 16—Factors accounting for Japan's import growth in cut flowers and selected vegetables, by country of origin, 1979-81 to 1987-89

Commodity/ Contry of Origin	Import Growth Rate[a]	Contribution of Price Changes					Contribution of Income Changes	Total Contribution[d]	Residual
		Country A[b]	Country B[b]	Country C[b]	ROW[b]	Substitutes[c]			
					(percent)				
Cut flowers									
Taiwan (A)	12.81	10.24	-0.09	8.95	-0.21	8.56	7.76	34.38	-21.57
Thailand (B)	21.59	-4.36	11.15	3.43	1.90	6.69	6.06	30.71	-8.42
Netherlands (C)	92.96	0.47	1.23	23.86	0.94	10.52	9.53	81.96	11.00
Onions									
Taiwan (A)	-3.43	1.28	-0.25	-5.30	1.30	-0.81	-0.29	-3.46	0.02
United States (B)	-4.94	-1.37	10.50	-2.80	-1.39	-3.65	-1.31	0.58	-5.52
New Zealand (C)	-6.32	-5.47	0.67	8.48	0.15	-5.58	-2.00	-3.14	-3.18
Green beans									
Thailand (A)	-2.06	5.84	...	...	-4.44	0.06	1.00	3.07	-5.14
Bamboo shoots, dried									
Taiwan (A)	-1.44	-1.43	0.95	...	0.03	...	-0.55	-0.24	-1.20
China (B)	21.62	5.56	-7.18	...	1.06	...	-0.32	-0.19	21.81
Bamboo shoots, canned									
Taiwan (A)	-8.06	-1.95	0.77	-10.22	-1.58	...	-0.23	-12.66	4.60
Thailand (B)	41.08	11.61	-25.87	32.87	0.48	...	19.74	44.18	-3.10
China (C)	54.93	0.05	0.09	11.43	-0.01	...	15.74	31.70	23.23
Ginger, nonpickled									
Taiwan (A)	10.59	-1.83	-2.87	9.47	-1.43	-11.46	11.88	10.57	0.02
Thailand (B)	44.50	0.04	10.49	-0.55	-0.09	-5.72	5.93	13.80	30.70
China (C)	11.99	0.32	-0.16	6.04	-0.67	-0.35	0.36	6.35	5.64
Ginger, pickled									
Taiwan (A)	-13.77	-13.95	-2.34	...	1.20	-0.98	3.94	-11.48	-2.30
Thailand (B)	36.93	0.48	0.16	...	0.15	-4.20	16.94	14.28	22.66

Note: Growth-accounting is conducted for the changes from 1979-81 to 1987-89 using compounded annual growth rates of variables: own price, competitors' prices, the price of substitutes, income, and the consumer price index.

[a]Based on annual growth rate of import quantity by country of origin.

[b]Country A, B, and C are the countries listed in the first column for each commodity, and ROW is the rest of the world.

[c]Includes the contribution of changes in alternative prices.

[d]Includes the population growth rate, the dummy variable effect for cut flowers, and the inflation effect on import expenditure.

Table 17—Factors accounting for Japan's import growth in selected fruits, by country of origin, 1979-81 to 1987-89

Commodity/ Contry of Origin	Import Growth Rate[a]	Conribution of Price Changes					Contribution of Income Changes	Total Contribution[d]	Residual
		Country A[b]	Country B[b]	Country C[b]	ROW[b]	Substitutes[c]			
					(percent)				
Bananas									
Taiwan (A)	0.68	3.07	0.34	...	-0.07	-0.68	-1.59	3.52	-2.84
Philippines (B)	-1.18	-1.68	-0.29	...	-0.29	0.32	0.76	-0.84	-0.33
Mangoes									
Philippines (A)	27.61	4.22	-1.06	...	-0.05	-0.11	5.31	10.18	17.43
Mexico (B)	7.58	-1.37	7.42	...	-0.02	-0.35	17.38	27.80	-20.22
Avocados									
Mexico (A)	26.42	19.19	-4.78	...	...	...	1.68	18.95	7.47
United States (B)	22.16	-0.41	12.07	...	...	...	2.73	18.66	3.50
Kiwifruit									
New Zealand (A)	40.64	42.16	...	...	2.06	-23.04	4.89	32.82	7.82
Pineapple, fresh									
Taiwan (A)	7.35	-2.90	2.49	...	0.04	-0.56	-0.70	1.90	5.45
Philippines (B)	2.51	2.34	4.11	...	-0.15	-0.47	-0.58	8.31	-5.80
Pineapple, frozen									
Taiwan (A)	-50.73	-7.39	-4.49	...	-0.18	-0.14	0.59	-11.95	-38.78
Thailand (B)	4.95	0.03	20.16	...	-2.84	-1.81	-7.56	11.47	-6.52
Pineapple, canned									
Taiwan (A)	-12.30	20.00	16.98	-33.34	-14.55	-0.74	4.19	-6.82	-5.48
Philippines (B)	1.54	-0.34	3.38	-1.80	-1.11	-0.50	2.85	3.10	-1.56
Thailand (C)	9.57	-0.26	-1.42	2.86	-0.86	-0.55	3.15	3.54	6.03

Note: Growth-accounting is conducted for the changes from 1979-81 to 1987-89 using compounded annual growth rates of variables: own price, competitors' prices, the price of substitutes, income, and the consumer price index.

[a]Based on annual growth rate of import quantity by country of origin.

[b]Country A, B, and C are the countries listed in the first column for each commodity, and ROW is the rest of the world.

[c]Includes the contribution of changes in alternative prices.

[d]Includes the population growth rate, the dummy variable effect for cut flowers, and the inflation effect on import expenditure.

The trade flows of canned bamboo shoots present an interesting example of price competition. As seen previously in Table 9, China alone decreased its price by 5.9 percent annually, whereas Taiwan and Thailand increased their prices by 0.9 and 2.7 percent, respectively. Therefore, the sign of the own-price change contribution is positive for China and negative for the other two, and the size of the contribution is a product of the price change rate by the own-price elasticity. The effects of China's price decline on imports from Taiwan and Thailand are interesting: the two competitors are led in different directions—Taiwan to negative growth and Thailand to positive growth.

China is the major supplier of canned bamboo shoots, accounting for 64 percent of Japan's imports in 1987-89. Therefore, the price decline in China causes a significant decline in the import price index of canned bamboo shoots, which in turn results in an increase in expenditure on total imports of canned bamboo shoots through the first-stage import demand equation. Such an increase in import expenditure benefits Thailand multiplicatively because Thailand has a large coefficient for the import expenditure variable in the trade-flow equation for canned bamboo shoots, as seen in the Appendix, Table 34. If the effect of the increase in import expenditure exceeds the substitution effect brought about by China's price decline in the trade-flow equation, China's price changes will contribute to positive growth in the competitor's exports, as happened in Thailand. On the other hand, the increase in import expenditure does not bring any change in Taiwan's exports because its coefficient of the import expenditure variable is negligible. Therefore, the substitution effect of the decline in the import price index through both own-price and cross-price variables in the trade-flow equation is dominant, and the contribution of China's price decline to growth of Taiwan's exports is negative.

Income changes are a product of Japan's income growth rate by the income elasticity of the trade flow.[25] Income growth is the most important single factor contributing to the growth of eight trade flows. Income growth contributed remarkably to the import growth of canned bamboo shoots from Thailand and China, nonpickled ginger from Taiwan, pickled ginger from Thailand, and mangoes from Mexico. Income contributions are purely proportional to the income elasticities of trade flows in Table 14 because Japan's income growth rate is the common factor by which all income elasticities are multiplied.

Contributions of individual factors sum to the total contribution.[26] The calculated total contribution may be interpreted as a potential import growth rate for each trade flow in the sense that it depends on the purified characteristics of Japan's import demand and on the trends of changes in independent variables. The differences between the realized import growth rates and the total contributions, which appear as residuals in the last columns in Tables 16 and 17, are unexplained. Sixteen of the 31 trade flows recorded positive residuals, which means that the realized import growth rate was higher than the potential growth rate, indicating

[25]The income growth rate and the price change rate of substitutes are defined in real terms so that the effect of inflation is taken into account for these variables.

[26]The total contribution includes the inflation effect on import expenditure, the dummy variable effect for cut flowers, and the population growth rate, which is necessary because the estimated equations are for per capita imports.

better performances of imports than expected. Positive residuals are particularly large for both types of bamboo shoots from China, both types of ginger from Thailand, and mangoes from the Philippines.

On the other hand, there are 15 trade flows for which negative residuals are recorded. The realized growth rates of these trade flows fell short of the total contributions and did not reach the potential growth rates for the 1979-81 to 1987-89 period. Particularly large negative residuals are recorded for the trade flows of cut flowers and frozen pineapple from Taiwan and mangoes from Mexico.

It is difficult to identify the factors that prevented these trade flows from realizing their potential growth rates. Differences between realized growth rates and total contributions are certainly subject to statistical errors in the estimated coefficients and random errors in 1979-81 or 1987-89. Residuals that are small relative to the realized import growth rates may be the result of such errors. However, the large residuals should be examined individually to look for other causes. Further investigation of residuals requires more detailed information on the market structure and related data for individual trade flows, but at this stage of research, three factors may be worth mentioning.

The first deals with quarantine regulations. Although phytosanitary regulations, which will be discussed in the next chapter, are faced by all horticultural imports, the ratio of rejected imports to planned imports as a result of imposed regulations may differ by source of imports. For example, in cut-flower trade, as mentioned in the previous chapter, the Netherlands have reduced the risk of rejection by introducing preshipment inspections. A part of the effects of this special treatment was captured by the dummy variable introduced in trade-flow equations for cut flowers, but the effects may go beyond that, resulting in significant differences in residuals between the Netherlands and the other two exporters.

The second factor is the market structure for imports. If the market tends to be less competitive, leaning toward monopsony, the price may divert demand, resulting in negative residuals. The coefficients applied for growth-accounting were mostly estimated using data for a longer period than 1979-81 to 1987-89. If the market structure has changed in recent years, the estimated coefficients tend to represent the previous structure more than the changed one, and the residual becomes larger than can be explained by statistical error. Imports of bananas and pineapple, which recorded negative residuals, used to be very competitive, with many small importers, but the number of importers was reduced dramatically in the course of market integration. Bananas and pineapple are now imported by a handful of large importers. This change may partly explain the negative residuals of banana and pineapple imports. To test this hypothesis, a formal empirical model of imperfect competition would be needed.

Finally, the importance of sales promotions by exporters should be emphasized. (These were already discussed for cut flowers and bananas in Chapter 4.) The success in mango exports from the Philippines to Japan is also the result of aggressive sales promotion by several Philippine exporters. Their activities included approaching the Japanese government to obtain official approval of their method of fumigation, which caused the ban on imports of mangoes from the Philippines to be lifted. Such efforts have probably resulted in a much higher import growth rate for Philippine mangoes than expected.

6

JAPAN'S POLICY AND DOMESTIC DISTRIBUTION

Policies on Horticulture

Imported horticultural products enter the market and are sold in competition with the domestic produce of Japan. Most imports of horticultural products, however, do not directly conflict with domestic products because of differences in kind and variety. For example, the most important domestic products in Japan are daikon radishes, cabbages, and Chinese cabbages in vegetables, and *mikans* (mandarin oranges), apples, and Japanese pears in fruits. Nevertheless, imported horticultural products do substitute to some extent for domestic products, as shown by the estimated positive coefficients of the substitute price variables in some regressions for import demand in the previous chapters. Therefore, in considering import growth, it is also important to examine Japan's domestic policies on horticulture.

In Japan, about 80 percent of farm households produce some vegetables, but most of these are for home consumption. The number of farms that marketed horticultural products were 606,000 for vegetables and 527,000 for fruits in 1990 (JMAFF 1990). They supply about 90 percent of the vegetables and 65 percent of the fruits consumed in Japan. Although Japanese agriculture is characterized by part-time farmers who typically produce rice, the staple crop, horticultural commodities are supplied mostly by full-time or nearly full-time farmers. More than 60 percent of horticultural output is produced on core farms, which are defined as farms with at least one economically active male (16-55 years old) engaged in farming for more than 150 days per year. In contrast the share of rice output produced by core farms is less than 30 percent (JMAFF 1989a). This means that the structure of horticultural production in Japan is sound, with professional farms that are land-saving and capital-intensive enterprises, especially in greenhouse vegetable production. Indeed, horticulture is one of the few agricultural industries that attracts young people to engage in agricultural careers in Japan.

Horticultural producers are more market-oriented and more responsive to market signals than other agricultural producers, partly as a result of less government intervention in this sector than in other agricultural sectors. Horticultural growers receive little direct support from the government despite the fact that cut flowers, vegetables, and fruits now account for about one-third of total agricultural production in gross output value. In other words, the horticultural industry has grown mainly through private efforts and without government intervention.

Nevertheless, horticultural growers are not perfectly independent of protection policies. For some producers of vegetables and fruits, a price support system is operated by the Vegetable Supply Stabilization Fund and the Fruit Supply Stabilization Fund, respectively. In Japan the market prices of horticultural products are

determined by auction in wholesale markets. As discussed later in this chapter, the prices determined by auction tend to fluctuate broadly and the shippers or producers cannot reject the sales of their products in auction even at a price lower than the cost. When market prices fall steeply, subsidies are paid to farmers to avoid severe income losses, making up the difference between the market price and a guaranteed level for the farmers' shipments. For example, the Vegetable Supply Stabilization Fund subsidizes the producers through registered shipping organizations for designated vegetables shipped on behalf of producers from 1,187 designated production areas to 34 designated consumption areas. The guaranteed price level is determined by taking into consideration past trends in market prices, production costs, and other economic factors; it is not directly or systematically related to border prices. The central government, prefectural governments, and shipping organizations all contribute to the funds required. Fourteen vegetables, including onions, are under this system.[27] In addition, nonprofit organizations set up in prefectures under the Civil Code carry out purchase, sale, and storage of vegetables as required, and grant subsidies to some vegetables other than the 14 designated ones (Masuda 1990). A similar system is operated by the Fruit Supply Stabilization Fund, which covers mandarin oranges, apples, pears, and peaches (for processing only).

From the exporter's point of view, border measures such as import tariffs, import quotas, and other nontariff barriers are a concern. The import quota on oranges has been publicized as a symbol of the closed nature of Japan's agricultural markets. But most import quotas have been removed. Among the commodities in this study, imports of canned pineapple were restricted by an import quota, but it was abolished in 1990.

Import tariff rates have also been reduced through bilateral or multilateral trade negotiations. The current tariff rates are summarized in Table 18.[28] In assessing duty for imports from developing countries, a preferential rate is applied before a GATT rate, a GATT rate before a temporary rate, and a temporary rate before a general rate. Therefore, most import tariff rates for developing countries are already low, except those on bananas and pineapple. Import tariff rates on bananas have been reduced gradually, but they are still as high as 20 percent on bananas imported during the period from October 1 to March 31, although rates are reduced to 10 percent for the rest of the year.[29] This seasonal differential tariff was introduced because domestic fruits, particularly apples, were thought to suffer from competition with bananas in the seasons when domestic products are in the market.

Unlike bananas, the import tariff rate on fresh pineapple has not changed at all, staying at 20 percent for more than 20 years. Because of the trend toward a general reduction in tariff rates over time, however, this fixed tariff rate on fresh pineapple gives the impression of a high barrier. The barrier against imports of pineapple,

[27]They are cabbages, cucumbers, taros, Japanese radishes, onions, tomatoes, eggplants, carrots, Welsh onions, Chinese cabbages, potatoes, sweet peppers, spinach, and lettuce.

[28]Basic data on horticultural imports to Japan, including tariff rates since 1965 and quantities, values, prices, and exchange rates, are available as a supplement to this report from the International Food Policy Research Institute.

[29]In the import demand analysis in Chapter 5, the import price of bananas is adjusted by the average of the two seasonal tariff rates weighted by the import quantity for each season.

Table 18—Japanese import tariff rates on selected horticultural products, 1989

Commodity	General	GATT	Preferential	Temporary
		(percent)		
Cut flowers	10	Free	Free	...
Vegetables				
Onions (1)[a]	10	...	...	10
Onions (2)[b]	10	...	...	Formula[c]
Onions (3)[d]	10	...	...	Free
Green beans	Free	Free	...	...
Bamboo shoots, dried	15	...	7.5	...
Bamboo shoots, canned	25	...	...	16
Ginger, nonpickled	10	5	Free	5
Ginger, pickled	15	...	...	...
Fruits				
Bananas (1)[e]	30	...	10	40
Bananas (2)[f]	30	...	20	50
Mangoes	20	...	4	...
Avocados	20	...	4	...
Kiwifruit	20	8	8	...
Pineapple, fresh	20	...	...	...
Pineapple, frozen	20	...	...	28
Pineapple, canned	45	30	...	55

Source: Japan Tariff Association, *Customs Tariff Schedules of Japan* (Tokyo: JTA, 1989).
[a]Not more than Y 67 per kilogram in value for customs duty.
[b]More than Y 67 per kilogram but not more than Y 73.70 per kilogram in value for customs duty.
[c](Y 73.70 - the value for customs duty)/kilogram.
[d]More than Y 73.70 per kilogram in value for customs duty.
[e]If imported during the period from April 1 to September 30.
[f]If imported during the period from October 1 to March 31.

especially canned pineapple, protects pineapple growers in Okinawa, where the domestic pineapple industry is concentrated. They ship their products to the major islands in Japan mostly in canned form. After the abolition of the import quota on canned pineapple in 1990, a tariff quota system was introduced on canned pineapple imports. Under this system, in exchange for purchasing one unit of canned pineapple from Okinawa, a trader is given a tariff quota by which 4.8 units of canned pineapple can be imported from abroad duty free. Otherwise, a 30 percent tariff is imposed on canned pineapple imports.

Japan's policies on horticulture seem less restrictive against imports than those of the EC countries, which form the largest horticultural market in the world. In addition to the Common Agricultural Policy (CAP) provisions, which support prices of fresh vegetables and fruits by compensating producers for withdrawing selected commodities from the market during the period of surplus, EC producers are protected from low-price imports from third countries by a reference price system. The system is operated so that when the import price for a particular commodity in a representative EC market falls below the reference price for a qualifying period, the importer is assessed an additional levy, or countervailing duty, equal to the difference between the reference and the import price. Nineteen types of vegetables and fruits are covered by this reference price system in the European Community. Thus, the reference prices act as minimum import prices, sometimes having prohibitive effects on imports, especially on tomato imports

(Alvensleben 1982 and Buckley 1990). The European Community also applies relatively higher tariffs on some commodities to keep imports from benefiting from the internal price support system (Buckley 1990). Meanwhile, several major countries and regions that produce horticultural products have established accords in order to receive preferential duty rates—the Lomé countries, for example. Furthermore, in the case of bananas, free circulation within the European Community is largely restricted by the national legislation of each member country. For example, the United Kingdom protects imports of bananas from the Caribbean against imports from other countries, France protects imports from Côte d'Ivoire and Cameroon, Italy protects imports from Somalia, and Spain protects imports from the Canary Islands. All member states of the European Community, except Germany, apply custom duties on imports of bananas from the dollar area; Germany imposes a duty-free quota covering its total consumption (Fairclough 1989).

Quarantine Regulations

Of the barriers against horticultural exports to Japan, the major concern for most developing countries is Japan's phytosanitary regulations. Japan's quarantine regulations are often criticized by exporters who consider them too restrictive and even irrational. It is difficult to distinguish unnecessary restrictions from necessary ones because standards and safety concerns about food sanitation, disease, and infestation differ widely by country. Following is a general description of Japan's quarantine regulations for plant imports, which are applied not only to vegetables and fruits, but to all other kinds of plants as well.

Because Japan is totally surrounded by seas and followed a policy of seclusionism for many years (1639-1854), invasions of pests and diseases from overseas were largely precluded. Once a pest or disease finds its way into Japan, however, there is great danger of its staying in the country, because the Japanese territory is oriented north to south, its climate varies widely from subarctic to subtropic, and cultivated land or farms are continuous. For these reasons, particular importance is attached to quarantine of plants in Japan. Although Japan failed to stop entry of fall webworm, potato tubeworm, and rice-water weevil, the entry of more harmful pests and diseases, such as fruit flies, codling moths, and potato wart diseases, have so far been prevented (JETRO 1986). Table 19 lists the countries from which plant imports are prohibited because of pests.

Japan requires that plants be brought into the country through a designated seaport or airport, with a plant inspection application form and a phytosanitary certificate issued by the plant quarantine authority of the exporting country attached. These must be submitted to the plant quarantine station, and the plants inspected by a plant quarantine officer. If the plant is found free from harmful pests or diseases the certificate of inspection is issued: if any pest or disease is detected, the certificate of inspection will be issued after disinfection has been completed.

After the regular quarantine inspection conducted at the time of import is over, fruit tree seedlings, flower bulbs, tuberous roots of sweet potatoes, tubers of potatoes, and live stems and leaves of sugarcane are required to undergo postentry cultivation for a preset period in order to detect possible viruses and other diseases that may not be found by the regular quarantine inspection.

Table 19—Major prohibited fruits, vegetables, and other plants

Regions and Countries from which Importation is Prohibited	Main Prohibited Items	Pests and Diseases
Europe, Middle and Near East, Africa, Australia, Brazil.	All fresh fruits (excluding fresh pineapple and coconut and fresh unripe banana), walnut in husks	Mediterrannean fruit fly, codling moth.
United States (excluding Hawaii), Canada, New Zealand	Fresh fruits such as apple, pear, plum, cherry, and walnut, wheat straw	Codling moth, Hessian fly
Hawaii	All fresh fruits (excluding fresh pineapple and coconut, and fresh unripe banana)	Mediterranean fruit fly, mango fly, melon fly
China	Fresh apple, pear, cherry, and walnut	Codling moth
China, Taiwan, Hong Kong, the Philippines, Indonesia, Thailand, Malaysia, Singapore, Burma, India, Pakistan, Guam, Saipan	Fresh citrus fruits such as ponkan, tankan, pompelmous, and lime, and fresh plum, papaya, longan, litchi, carambola, guava, avocado, rambutan, mango, star apple, sapodilla, eugenia, anona, mangosteen, eggplant, tomato, capsicum, watermelon, cucumber, momordica, pumpkin, and fresh ripe banana	Mango fly, melon fly
Tahiti, Easter Island, New Caledonia, Papua New Guinea	Fresh citrus fruits such as orange, fresh papaya, carambola, guava, avocado, passion fruit, mango, eugenia, anona, kiwifruit, date, and fresh ripe banana	Queensland fruit fly

Source: JETRO (Japan External Trade Organization), *Plant Quarantine in Japan* (Tokyo: JETRO, 1986).
Notes: Besides the list, the following are also prohibited entry: Some plants with roots or underground parts from the United States (including Hawaii) for possible presence of burrowing nematode (Radopholus citrophilus); rice plant, rice straw, rice husk, and unhulled rice from all regions and countries except the Korean Peninsula and Taiwan; and soil and plants with soil.

Plants that are prohibited may sometimes be imported if they are processed in the following manner: immersed in salt, sugar, sulfurous acid, or other approved substances; dried; heated; or frozen at a temperature of−17.8°C or lower.

Even the ban on plants prohibited under the Plant Quarantine Law may be lifted if predetermined conditions are met and public hearings are held. Technical reasons for the ban will no longer exist when the following conditions are satisfied:

- The pests in question have been exterminated in the country of origin and that fact is confirmed by Japanese experts.
- A technology for totally exterminating the pests in the country of origin has been established, and that technology is confirmed to be 100 percent effective by Japanese experts.

The countries and plants that have been authorized under this system are listed in Table 20.

The methods of disinfection in use have been established by each exporting country through repeated tests run over a number of years and include such

Table 20—Commodities and countries for which the ban has been lifted and treatments accepted

Country/Area	Commodity	Pest	Disinfection Method
Philippines	Mango	Mango fly, melon fly	Vapor heat treatment
Israel	Orange, lemon, grapefruit	Mediterranean fruit fly	Cold treatment
United States	Cherry	Codling moth	Methyl bromide fumigation
	Walnut, in shell	Codling moth	Methyl bromide fumigation
	Nectarine	Codling moth	Methyl bromide fumigation
Hawaii	Papaya	Mediterranean fruit fly, mango fly, melon fly	Vapor heat treatment
Canada	Cherry	Codling moth	Methyl bromide fumigation
Australia	Orange	Mediterranean fruit fly, Queensland fruit fly	Cold treatment
South Africa	Orange, lemon, grapefruit	Mediterranean fruit fly	Cold treatment
Swaziland	Orange, grapefruit	Mediterranean fruit fly	Cold treatment
New Zealand	Cherry, nectarine	Codling moth	Methyl bromide fumigation
Taiwan	Tancan orange, ponkan orange, Liutin variety of sweet orange	Mango fly	Vapor heat treatment or cold treatment
	Litchi	Mango fly	Vapor heat treatment
	Papaya	Mango fly, melon fly	Vapor heat treatment
	Mango	Mango fly, melon fly	Vapor heat treatment
Thailand	Mango	Mango fly, melon fly	Vapor heat treatment
Chile	Grape	Mediterranean fruit fly	Cold treatment
China	Hamigua	Melon fly	From domestically inspected areas
Spain	Lemon	Mediterranean fruit fly	Cold treatment

Source: Japan Vegetable and Fruit Import Safety Promotion Association, *Statistical Data of Imported Vegetables and Fruits* (Tokyo: JVFISPA, 1990).

methods as fumigation with methyl bromide, low temperature treatment, and heat treatment. Ethylene dibromide (EDB) used to be extensively used for fumigation and disinfection, but it has been banned in Japan since 1988 because of its suspected carcinogenicity. The United States has also banned the use of EDB and restrictions on EDB are a worldwide trend.

With this new development, exporters who relied on EDB fumigation had to change their method of disinfection. For example, when mango exporters in the Philippines switched to more costly vapor heat treatment, the export price of Philippine mangoes jumped from US$1.20 per kilogram in 1987 to US$1.85 per kilogram in 1988.[30] The increases in export costs have spurred a reorganization of the mango industry in the Philippines, in which mangoes are produced and exported by relatively large growers and exporters to take advantage of scale economies; small producers and exporters are no longer able to export mangoes at the same price as before.

[30]In an interview with Philippine fruit exporters, it was reported that the cost of fumigation with EDB is about 10 cents per kilogram of mangoes in U.S. dollars, whereas the vapor heat treatment costs about 60 cents per kilogram.

Japan's phytosanitary regulations have brought a number of complaints from exporters, identifying many specific problems. For example, vegetables are fumigated if a single aphid is present despite the fact that aphids are "cosmopolitan pests" and commonly found in Japan. Japan is concerned about different "biotypes" and thus requires fumigation to avoid infestation with a mutant strain of aphid. The same applies to quarantine restrictions for Latania scale. Scale is commonly found in Japan, yet fumigation is required if the pest is found during port inspection (CSWTC 1986). Some complaints are also directed toward inspection operations. To cope with rapidly increasing imports of horticultural products, the number of air cargo inspectors and fumigation chambers were increased. However, the number of food sanitation inspectors has not increased enough for prompt inspection. The number of hours taken for inspection is crucial for exporters because most horticultural products are perishable and a delay in delivery may result in quality deterioration.

In the Uruguay Round negotiations of the General Agreement on Tariffs and Trade (GATT), the contracting countries have tried to establish a system of multilateral rules and descriptions to guide the application of sanitary and phytosanitary measures, and to develop standard guidelines and recommendations with respect to all aspects of sanitary and phytosanitary measures. Harmonizing sanitary and phytosanitary measures is now on the agenda for international trade talks. In the Uruguay Round, however, progress toward an agreement in this field has been blocked by the deadlock in agricultural negotiations to reduce protection policies in developed countries.

Any government may interfere with traded agricultural products on health and safety grounds, but they should do so only when the scientific evidence justifies it. In addition to scientific investigations, it is also important to identify the effects on trade of technical barriers. The technical barriers may be classified into groups according to their roles. Lynham (1987) suggests the following classification:

- Protective: restrictive trade practices that increase the price (cost of production and marketing) of imported goods.
- Trade-diverting: restrictive trade practices that divert trade across firms or countries because of the differential or prohibitive cost of compliance.
- Trade-neutral: restrictive trade practices that affect the cost of all producers and hence increase the consumer price of both domestic production and imports.

Since this framework identifies the increased cost of discriminatory quarantine regulations, a tariff equivalent or a nominal rate of protection could be calculated (Bredahl and Forsythe 1989). Such a task could be conducted through international collaboration, as producer and consumer subsidy equivalents are calculated by the Organization of Economic Cooperation and Development.

Domestic Distribution

Countries that export horticultural products are also concerned about Japan's distribution system, which their products must pass through. Domestic producers and import traders can sell their commodities through wholesale markets or directly to supermarkets and large processors, restaurants, school lunch centers, and others.

Wholesale markets account for nearly 100 percent of sales of cut flowers and 80-90 percent of vegetables and fruits in normal trading. Therefore, wholesale markets are the key to understanding the distribution system for horticultural products in Japan.

There were 91 central wholesale markets in 56 cities and 1,691 local wholesale markets spread across Japan in 1986. The purchasers of horticultural products in the wholesale market are intermediate wholesalers who sell the products to retailers or large users. Because today's wholesale markets are overly subdivided into regions, the possibility of integrating them is being examined, to rationalize distribution and allow a wider selection of products at each wholesale market. Indeed, in Tokyo metropolitan area, such integration has already started. A large central wholesale market was opened in 1989 with expected daily transactions of 125,000 cut flowers, 3,000 tons of fruits and vegetables, and 300 tons of fishery products.

The most important role of wholesale markets in Japan is price formation by auction. The prices of products in wholesale markets are determined by competition among purchasers, given a fixed amount of supply a day. The auction is conducted under the regulations of the Wholesale Market Laws. Only wholesalers who have a license can sell the products, but they are just consignees entrusted by shippers of produce or import traders and cannot receive more than the consignment fee. The wholesalers cannot reject any consignment by shippers without a justified reason and can sell only the products actually delivered to the market.

Therefore, in a sense, the auction is very competitive, and there is little possibility of price control, whereby price formation in wholesale markets is considered "fair." However, for those commodities with small price elasticities, the price determined in the auction tends to fluctuate widely as the daily supply changes. Once shippers consign their products to wholesalers, the shippers cannot reject the sales of their products, even if the auctioned price is lower than the cost. One method of avoiding this risk is to disperse shipments to wholesale markets throughout the country.

For import traders, it is risky to auction imported commodities that are contracted at a fixed price with exporters. Traders tend to sell the products directly to intermediate wholesalers, large users, and supermarkets, bypassing the wholesale markets. For buyers who demand a fixed amount of a product daily, such as processors, restaurants, and take-out lunch businesses, it is desirable to secure a stable supply with a contract. In addition, some large supermarket chains have networks and pipelines of imports and, therefore, purchase the imports through their own routes. As a result, the ratio of imported vegetables and fruits sold by auction is smaller than that of domestic products, although imported cut flowers are sold mostly through wholesale markets.

The final stage in the distribution of horticultural products is the retail market. Horticultural products, particularly fresh vegetables, are the commodities most frequently purchased daily by consumers because freshness is the most important factor, given their perishable nature. In Japan, 74 percent of consumers purchase vegetables every day or every other day and 78 percent purchase at retail shops within a 15-minute walking distance from home (Toda 1989). This explains why there are so many retail shops that sell horticultural products in Japan: about 130,000 retail shops sell vegetables and fruits and 25,000 sell flowers. Most of

them are small in size, and their annual sales averaged less than 20 million yen in 1986.

Through the distribution system described above, horticultural products are delivered to consumers. The prices consumers pay for the products reflect both production and distribution costs. Table 21 shows the composition of retail prices for six vegetables and fruits. The composition differs by commodity but, roughly speaking, distribution costs account for 50-70 percent of the retail price, and the amount paid to producers is less than half of the retail price. The margin at retail levels is especially large, accounting for 30-50 percent of the retail price. The high ratio of distribution costs in marketing channels is observed not only in Japan but also in other countries. For example, in the United States, the margin accounts for 47 percent of the retail price for lettuce and 43 percent of the retail price for oranges (Takahashi 1991). The distribution costs for bananas are particularly large, though the figures for bananas cannot be directly compared with other commodities in the list because of different sources of data. The margin for bananas at the wholesale level includes tariffs and processing costs for ripening because the import price is c.i.f., and only green bananas are imported due to quarantine restrictions. Nonetheless, the margin for bananas at retail is much higher than at wholesale, accounting for about half of the retail price.

The composition of retail prices indicates how important the distribution costs are in the formation of prices for horticultural commodities. Improvements in efficiency of the distribution system have long been recommended as essential for

Table 21—Distribution costs of six vegetables and fruits, 1988

Commodity	Producer Price (1)	Wholesale Price (2)	Retail Price (3)	Margin at Wholesale (2-1)[a]	Margin at Retail (3-2)[b]	Distribution Costs (3-1)
			(Y/10 kilograms)			
Onions	638	1,050	1,700	412 (24.2)	650 (38.2)	1,060 (62.5)
Cabbages	1,001	1,378	2,067	377 (18.2)	689 (33.3)	1,066 (51.6)
Tomatoes	3,469	4,500	7,000	1,031 (14.7)	2,500 (35.7)	3,531 (50.4)
Mandarin oranges *(mikans)*	1,989	2,689	4,111	700 (17.0)	1,422 (34.6)	2,122 (51.6)
Apples	2,272	3,100	5,277	828 (15.7)	2,177 (41.3)	3,005 (56.9)
Bananas	730[c]	1,170	2,320	440 (19.0)	1,150 (49.6)	1,590 (68.5)

Source: JMAFF (Japan, Ministry of Agriculture, Forestry, and Fisheries), *Horticultural Statistics* (Tokyo: Norin Tokei Kyokai, 1989).

Note: Results are from a survey conducted in November 1988, except for bananas, for which the figures are the 1988 average at each stage of distribution. Figures in parentheses are the percentage of the retail price.

[a]Includes shipping cost from farmgate to wholesale market.

[b]Includes margin for intermediate wholesalers.

[c]This is the c.i.f. import price.

reducing consumer prices, which in general are higher in Japan than in other developed countries. One development that has contributed to a more efficient distribution system is the increase in supermarkets. Supermarkets take advantage of scale economies and provide cheaper commodities with wider selections. Consumers have been significantly influenced in their shopping patterns by the increase in supermarkets. In 1964 about three-quarters of fresh vegetables (in value) were purchased at ordinary retail shops, but by 1984, that figure dropped to less than 40 percent by 1984 (Toda 1989). Today, more than half of the fresh vegetables are distributed through supermarkets in Japan.

In the wake of rapid increases in supermarkets in the early 1970s, the Large Retail Store Law was enacted in 1974 to protect small retailers from competition with large retailers. The law regulates the opening of major retail operations and applies to outlets with a selling space of 500 square meters (5,382 square feet) or more. Large retailers who are interested in opening a new outlet are required to have the plan approved by the Chamber of Commerce and Industry and the retailers's group in the region. The details of the plan are also examined by a council of local retailers, consumers, and academics. In the process, changes to the plan may be recommended. The procedure is finalized by the Minister of International Trade and Industry. It takes years to complete this procedure. The Large Retail Store Law is also viewed as a barrier to the entrance of foreign-made goods into Japanese markets. Indeed, the law was a top item on the agenda of the talks on the Structural Impediments Initiative (SII) between Japan and the United States in 1990, and Japan promised to cut the time it takes to complete the approval process to less than 18 months.

The cost efficiency of distribution through large retailers is shown in Table 22, which indicates retail costs of vegetable and fruit sales by types of retail shops. There are significant differences in retail costs for both vegetable and fruit sales between supermarkets and ordinary small shops whose annual sales are less than 30 million yen. Sale of one ton of vegetables costs the small shops Y65,000 added to the cost of the commodities at retail, whereas it costs supermarkets just Y53,000 on the same sales—about 20 percent less than the cost of the small shops. The ratio is about the same for fruit sales, too. The differences result mainly from economies of scale that supermarkets can exploit with a larger volume of sales. The amount of sales determines the costs of retail business as seen in the differences between ordinary shops whose sales are more than Y30 million and those whose sales are less; the former are 15 percent more efficient than the latter. Table 22 also shows the cost factors of land and building rent and labor cost. Surprisingly, there is not much difference in the ratio of land and building rent to the total cost by type of shop, but the share of labor costs in supermarkets is clearly smaller than that of ordinary shops, even larger shops.

Wide selection and lower prices are the key factors explaining the rapid expansion of sales through supermarkets. Low price is still an important factor, but at present competition among retail shops centers more on quality and variety than on price. Consumers in Japan are willing to pay higher prices for higher quality, and they are also looking for something different in the products they purchase. This is particularly true for cut flowers and fruits, where many different varieties are available in the same shop to meet different demands. Retail shops that sell horticultural products tend to be separated into two different types; one concen-

Table 22—Retail costs of vegetable and fruit sales, 1987

Item	Ordinary Shop with Sales of		Supermarket
	Less than Y 30 million	More than Y 30 million	
	(Y/metric ton)		
Vegetable sales			
Land and building rent	6,579 (10.1)	5,478 (9.9)	4,808 (9.9)
Labor cost	38,690 (59.3)	33,777 (61.2)	29,507 (55.3)
Total cost	65,249 (100.0)	55,153 (100.0)	53,337 (100.0)
Fruit sales			
Land and building rent	6,581 (8.8)	6,023 (9.3)	4,806 (7.8)
Labor cost	44,741 (60.1)	39,048 (60.4)	33,293 (54.1)
Total cost	74,458 (100.0)	64,648 (100.0)	61,495 (100.0)

Source: JMAFF (Japan, Ministry of Agriculture, Forestry, and Fisheries), *Horticultural Statistics* (Tokyo: Norin Tokei Kyokai, 1989).

Notes: These figures are the results of a survey conducted for large cities. Figures in parentheses are the percent of the total cost.

trates on products of high quality and high prices, and the other deals in large volume and low prices. Therefore, production and imports on the supply side are also expected to reorganize in this direction.

Reduction in Distribution Costs and Tariff Rates

All the policies discussed in the previous sections in this chapter have some effect on horticultural imports, whether the quantity imported is large or small. It is, however, difficult to quantify the real effects because of the complicated implementation and uncertain effectiveness of policies. Quarantine regulations are especially difficult to assess quantitatively without extensive research on technical aspects. To evaluate policy within the framework of this study, an effort is made to capture the effects of reductions in distribution costs and tariff rates.

The distribution costs can be reduced by introducing more efficient marketing channels; supermarkets could be increased by abolishing the Large Retail Store Law, for example. As seen in Table 22, the retail costs of large shops and supermarkets are about 20 percent less than those of ordinary small shops in both vegetable and fruit sales. The ratio of sales in small shops to the total sales is not known, but it is assumed to be about 50 percent, judging from the previous discussion on fresh vegetable sales. Therefore, a 10 percent decline is expected in prices of horticultural products at retail levels if all retail shops could make their sales operations as efficient through competition as the supermarkets currently do.

The ratio of the distribution cost to the retail price is 57 percent, on average, for the six commodities reported in Table 21. Thus, the price decline of 10 percent at the retail level has the same effect on imports because the demand schedules at the port are shifted upward by 5.7 percent along the price axis. Similarly, an import tariff reduction shifts the import demand schedule upward by the same percentage as the tariff rate.

Therefore, if the supply of horticultural imports is horizontal at current c.i.f. price levels for the quantity range under consideration, how the reductions in distribution costs and tariff rates would affect the imports can be assessed by using the estimated parameters of import demand equations. The reductions in distribution costs and import tariffs apply uniformly to all the foreign suppliers of the commodity, so that the effects on the imports are calculated with the coefficient of the import price variable ($_1$) in the first-stage import demand equation (11), multiplied by the coefficient of the import expenditure variable ($_i$) in the trade-flow equation (7).

The effects of reducing distribution costs by 5.7 percent and eliminating tariffs on horticultural imports are calculated in Table 23. Because the estimated coefficients of the import price variable for onions and green beans have wrong signs, those commodities are omitted from the table. The effects of distribution cost reduction are proportional to the magnitude of the multiplied demand parameters. Among the trade flows from developing countries, reduction of the distribution costs would be beneficial for cut flowers and nonpickled ginger from Taiwan, cut flowers and canned bamboo shoots from Thailand, canned bamboo shoots from China, and mangoes from Mexico, all of which would increase by more than 10 percent. The effects of reducing tariffs to zero depend on the current tariff rates as well as the demand parameters. Tariff reductions would increase imports substantially of canned bamboo shoots and frozen pineapple from Thailand, of canned bamboo shoots from China, of fresh pineapple from Taiwan and the Philippines, and of kiwifruit from New Zealand, all of which would increase by more than 20 percent.

It is noteworthy that neither reduction of the distribution cost nor the tariff would affect imports of bananas from the Philippines. This results from the negative but insignificant estimate of the import expenditure coefficient, which is therefore set at zero in this calculation. Reduction of the distribution cost and the tariff would increase the total imports of bananas but not imports from the Philippines as long as the relative prices among the suppliers remain the same. The only way for the Philippines to increase banana exports to Japan would be to reduce the price relative to other suppliers' prices, unless they rely on nonprice factors such as sales promotion activities. The same applies to canned bamboo shoots from Taiwan.

The sum of the effects of the distribution costs and the tariff rate reductions varies by commodity and by country. Thailand would benefit from sharp export increases in canned bamboo shoots and frozen pineapple of nearly 50 percent each, if the distribution costs and the tariff rates were reduced simultaneously. The sum of the effects on the Philippines and Taiwan for fresh pineapple, on China for canned bamboo shoots, and on New Zealand for kiwifruit would also be great, with increases ranging from 30-40 percent. On the other hand, the import demand for dried bamboo shoots, pickled ginger, and canned pineapple would not be affected much by such policy changes.

Table 23—Effects of reduction in domestic distribution costs and import tariff rates on Japanese horticultural imports, as a percent of current imports

Commodity/ Country of Origin	Distribution Cost Reduction of 5.7 Percent	Tariff Rate Reduction to 0 Percent	Sum of the Effects
		(percent)	
Cut flowers			
Taiwan	16.1	0.0	16.1
Thailand	12.5	0.0	12.5
Netherlands	19.8	0.0	19.8
Bamboo shoots, dried			
Taiwan	0.4	0.5	1.0
China	0.2	0.3	0.6
Bamboo shoots, canned			
Taiwan	0.0	0.0	0.0
Thailand	13.2	36.9	50.1
China	10.5	29.5	39.9
Ginger, nonpickled			
Taiwan	17.2	0.0	17.2
Thailand	8.6	0.0	8.6
China	0.5	0.0	0.5
Ginger pickled			
Taiwan	0.1	0.2	0.3
Thailand	0.4	1.0	1.3
Bananas			
Taiwan	5.1	12.8	17.9
Philippines	0.0	0.0	0.0
Mangoes			
Philippines	3.5	2.4	5.9
Mexico	11.4	8.0	19.4
Avocados			
Mexico	6.2	4.4	10.6
United States	10.1	7.1	17.2
Kiwifruit			
New Zealand	17.0	23.9	40.9
Pineapple, fresh			
Taiwan	8.1	28.3	36.4
Philippines	6.8	23.8	30.6
Pineapple, frozen			
Taiwan	0.6	3.0	3.7
Thailand	7.9	39.0	46.9
Pineapple, canned			
Taiwan	0.1	0.3	0.3
Philippines	0.0	0.2	0.2
Thailand	0.0	0.2	0.3

7

INTERNATIONAL TRANSPORTATION AND PRICE DETERMINATION

International Price Linkage

In the previous chapter, the importance of domestic distribution costs was recognized. How do costs affect international distribution? The international price linkage is examined by looking at the relationship between the export price and import price of the same commodity. However, because the classification of trade statistics differs by country, some export prices corresponding to import prices of the trade flows in this study are not available. Using the foreign trade statistics of Taiwan, Thailand, and the Philippines, export price data for 16 trade flows are collected and compared with corresponding Japanese import prices (Table 24).

The differences between import prices and export prices are usually transportation costs and marketing margins in international shipping. The ratio of export price to import price differs widely by commodity and by origin. For cut flowers, export prices are not much different in Taiwan than in Thailand, but on arrival in Japan, there is a wide gap between the two prices. This is caused by the difference in means of transportation: Taiwan ships their cut flowers to Japan by boat, whereas Thailand uses air cargo to ship their orchids. In general, the ratio of export price to import price is smaller for the products from Taiwan, reflecting its shorter distance from Japan.

The ratio of export price to import price is just 30 percent for Philippine bananas and pineapple, which means that Japan pays 70 percent of banana and pineapple prices to international distributers and only 30 percent is received by Philippine exporters. The ratio for Taiwan bananas and pineapple is almost reversed. The difference in distribution costs between Taiwan and the Philippines is attributed partly to the difference in distance from Japan. But it may also be attributed to the difference in organization of the fruit industry in the two countries. In the Philippines, the banana and pineapple industries are concentrated in a handful of multinational corporations, which operate through contracts with large plantations, whereas in Taiwan the banana and pineapple industries consist of many small growers. The multinational corporations in the Philippines are vertically integrated with international shipping and transportation companies. For example, the Dole Company in the Philippines sells its products to its mother company, Castle and Cook, which manages the international transportation and shipping arrangements. Then the products are sold to Japan's contracted import trader, Chu-Ito Company, which is one of a handful of trading companies in Japan that imports fruits from the Philippines. In such a vertical integration, the export price is simply a booking charge on transactions within the corporation group and can be set to maximize the total profit of the group rather than to reflect the

Table 24—Export and import prices of selected horticultural products imported to Japan, 1987-89 average

Commodity/ Country of Origin	F.O.B. Price[a]	C.I.F. Price[b]	F.O.B./C.I.F.
		(US cents/kilogram)	
Cut flowers			
Taiwan	201.8	277.6	0.727
Thailand	234.5	885.3	0.265
Onion			
Taiwan	29.7	34.2	0.868
Bamboo shoots, canned			
Taiwan	97.6	125.1	0.781
Thailand	58.4	88.0	0.664
Ginger			
Taiwan (pickled ginger)	88.0	88.3	0.996
Thailand	59.9	79.1	0.757
Green beans			
Thailand	45.4	48.6	0.936
Bananas			
Taiwan	48.2	66.9	0.720
Philippines	15.8	51.0	0.309
Mangoes			
Philippines	138.4	236.8	0.585
Pineapple, fresh			
Taiwan	70.5	90.6	0.777
Philippines	14.2	47.2	0.301
Pineapple, canned			
Taiwan	92.0	113.5	0.810
Philippines	53.9	109.8	0.491
Thailand	83.1	92.4	0.899

Sources: Japan Tariff Association, *Japan Exports and Imports (Commodity by Country)* (Tokyo: JTA, various years); Philippines, National Statistics Office, *Foreign Trade Statistics of the Philippines* (Manila: PNSO, various years); Republic of China Statistical Department, *Monthly Statistics of Trade* (Taipei: ROCSD, various years); Thailand, Finance Ministry, *Foreign Trade Statistics of Thailand* (Bangkok: TFM, various years).

Note: For Thailand and the Philippines, the 1986-88 average is used.

[a]The f.o.b. prices are the prices of exports in the countries exporting to Japan.

[b]The c.i.f. prices are the prices of imports upon entry into Japan.

marginal cost in production. The multinational corporations can transfer the pricing mechanism from one section to another within the integrated organization. Therefore, the difference in the export prices of bananas and pineapple between the Philippines and Taiwan may reflect a difference in industrial organization in addition to a difference in production costs.

Four factors affect the differences between import prices and export prices. First is the markup or marketing margin, which is part of the business of international distribution. Second is the transportation cost, which is determined by the distance from Japan. Third is the cost associated with the different treatment required in shipping the various commodities. Fourth are the factors specific to different countries, including differences in industrial organization and infrastructure. The effects of such factors are roughly captured by a regression model of the following relationship between import and export prices:

$$\ln PM_{ij} = \alpha \ln PX_{ij} + \beta_i DD_i + \gamma_j DC_j , \quad (16)$$

where PM_{ij} is the c.i.f. import price and PX_{ij} is the f.o.b. export price of commodity j from country i expressed in U.S. cents per kilogram; DD_i is the distance from country i to Japan; and DC_j is a dummy variable representing a specific cost factor to commodity j.[31] If the markup or marketing margin is a constant ratio to the export price, α is expected to be unity and γ_j consists of the common markup ratio and the commodity-specific cost effect. β_i also consists of two parts: the common transportation cost factor associated with distance and the country-specific factor. Therefore, the estimated coefficients of β_i and γ_j are subject to the test for equality. If there is a significant difference among them, it is attributed to either a country or commodity-specific factor.

The regression model for international price linkages expressed in equation (16) is applied to pooled data of 238 observations on import prices and export prices for the 16 trade flows over time. The data on import prices were obtained from the Japan Tariff Association, *Japan Exports and Imports* (various years); and other data from the Republic of China Statistical Department, *Monthly Statistics of Trade* (various years); Finance Ministry of Thailand, *Foreign Trade Statistics of Thailand* (various years); and the Philippine National Statistics Office, *Foreign Trade Statistics of the Philippines* (various years). The distance from Japan is taken from airline route mileage from Narita to Taipei, Bangkok, and Manila for Taiwan, Thailand, and the Philippines, respectively.

The ordinary least squares method (OLS) is used to obtain the regression results (Table 25). First, f.o.b. export prices are significantly correlated to c.i.f. import prices, but the coefficient of the f.o.b. export price variable is about 0.9—statistically less than unity with a 1 percent significance level. The changes in export prices are not perfectly transmitted to import price changes; about 10 percent are absorbed in the international distribution. In other words, the market margins seem to be adjusted through export price changes rather than strictly by taking a fixed ratio.

The coefficients of the distance variable show interesting results. The differences in the estimated coefficients by origin reveal some country-specific factors beyond the distance effect in the international distribution. The joint equality of all three coefficients of β_i and any pairwise equality among the coefficients are rejected. The most costly transportation per mile is for the products from the Philippines and the least is for the products from Thailand; Taiwan is positioned in the middle. This order of effectiveness of country factors may reflect efficiencies in the transportation industry by country. But the differences in exporters also seem to affect the order. The multinational corporations of the Philippines are integrated with international transportation. Taiwan exports horticultural products mainly through agricultural cooperatives that monopolize the export business, such as the Taiwan Fruit Marketing Cooperative, and may be more interested in stable transportation arrangements than in cost efficiencies. Thailand's exporters,

[31] DD_i takes the value of the distance from country i to Japan for the products from country i and a value of zero otherwise. DC_j takes a value of one for the price of commodity j and a value of zero otherwise.

Table 25—Results of regression of Japan's c.i.f. import prices of selected horticultural products on f.o.b. export prices, with distance and commodity dummies

Variable	Coefficient	t-Value
F.o.b. export price	0.8948**	30.31
Distance from		
Taiwan	0.3073**	3.72
Thailand	0.1950**	5.15
Philippines	0.5067**	10.33
Commodity dummy		
Cut flowers	0.9184**	11.85
Bamboo shoots	0.1369*	2.40
Ginger	0.1190	1.93
Bananas	0.1805**	3.05
Mangoes	0.2033	1.84
Pineapple, fresh	0.5489**	8.72
Pineapple, canned	0.0902	1.54

Notes: The number of observations is 238. $\bar{R}^2$, the adjusted coefficient of determination, is 0.959. The standard error of estimation is 0.208.
*Significant at the 5 percent level.
**Significant at the 1 percent level.

however, are relatively small and tend to minimize the transportation cost by seeking the lowest rates.

The coefficients of the commodity dummies represent specific costs associated with special treatment required for shipping each commodity. Note that the dummy variable for green beans is excluded from the regression to avoid singularity of the cross-product matrix in the regression procedure. Therefore, the coefficient for each commodity indicates the difference from that of green beans. Because of their delicacy, cut flowers need special handling in shipping and therefore show a large and highly significant coefficient. Fresh pineapple, bananas, and bamboo shoots, whose coefficients are all significant at least at the 5 percent level, all require costly shipping procedures regardless of the origin of the products. Shipping of ginger, mangoes, and canned pineapple is not significantly costly compared with green beans, as shown by their small coefficients with low t-values.

Price Transmission by Trade Flow

The regression analysis using pooled data gives useful information on the structure of the international distribution system. However, it is necessary to investigate price relations by trade flow if the import demand analysis is to be connected to supply conditions in exporting countries. Price relations should be examined between import prices in the importer's currency and export prices in the exporter's currency because decisionmaking in demand and supply depends on price variables expressed in their own currencies. Therefore, the exchange rate is included as another explanatory variable in the price linkage, and the transmissibility is examined for two factors: export price transmissions and exchange rate

transmissions.[32] For this purpose, the following price transmission equations are estimated for each of the 16 trade flows listed in Table 24:

$$\ln PM_{ij} = \alpha_{ij} + \beta_{ij} \ln PX_{ij} + \gamma_{ij} \ln EX_i , \quad (17)$$

where PM_{ij} is the import price in the importer's currency and PX_{ij} is the export price in the exporter's currency of commodity j from country i, and EX_i is the exchange rate for the importer's currency per unit of the exporter's currency.

The results of the estimated transmission equations are presented in Table 26. Most of the coefficients are significantly different from zero. However, if the price transmission is perfect, the coefficients of both the export price variable and exchange rate variable are expected to be unity. Therefore, a joint hypothesis of unity for $\beta_{ij} = \gamma_{ij} = 1$ is first tested on each trade flow. Only 7 of the 16 trade flows do not reject the hypothesis at the 10 percent level. These include the trade flows for onions, canned bamboo shoots, ginger, bananas, and canned pineapple, all from Taiwan, ginger from Thailand, and mangoes from the Philippines. All other trade flows reject the joint unity hypothesis, indicating that either the export price or exchange rate changes or both are not being transmitted to import prices well.

To identify the reason for the reduced transmissibility of those trade flows, individual coefficients of the export price and exchange rate variables are tested if either is significantly different from unity. The export price coefficients are significantly less than unity at least at the 10 percent level for cut flowers, green beans, and canned pineapple from Thailand and for fresh and canned pineapple from the Philippines. The export price coefficients represent the sensitivity of import price changes to export price changes when the exchange rate is fixed. Therefore, if the coefficient is significantly less than unity, it means that the export price changes are partly absorbed in the process of international distribution. During the estimation period, all export prices of the commodities whose coefficients are significantly less than unity, except cut flowers, increased in the exporter's currency, but such increases in export prices were partly offset by cost reductions in either international transportation or declines in market margin or both. In the case of cut flowers from Thailand, export price changes were not transmitted at all—the coefficient is not statistically different from zero: the price changes in Thailand were mostly absorbed when the cut flowers arrived in Japan. This happened because the dominant factor in the import price of cut flowers from Thailand is the cost of transporting the flowers by air cargo, which fluctuates over time. Therefore, import price changes are not directly correlated to export price changes in cut flowers from Thailand.[33]

[32]Presumably, import price changes would also reflect changes in transport costs. In preliminary regressions, a transport cost factor was introduced as an explanatory variable expressed in the ratio of total import values to total import values in Japan, representing an overall transportation cost change. But it did not result in significant coefficients for most trade flows, and the variable was omitted in the final regressions.

[33]Therefore, the transmission equation (17) is misspecified for cut flowers from Thailand because it excludes an important variable of air transportation cost. Data of transport cost by commodity are required for further investigations.

Table 26—Estimated transmission equations o. Japan's import prices for selected horticultural products

Commodity/ Country of Origin	Variables to Be Transmitted: Export Price	Variables to Be Transmitted: Exchange Rate	Constant	$\bar{R}^2$
Cut flowers				
Taiwan, 1974-89	0.900	1.398	0.701	0.628
	(3.27)	(5.19)	(0.25)	
Thailand, 1975-88	-0.124	0.729	11.527	0.875
	(-0.96)	(9.55)	(10.33)	
Onion				
Taiwan, 1980-89[a]	0.904	0.867	0.608	0.971
	(17.38)	(3.71)	(1.30)	
Bamboo shoots, canned				
Taiwan, 1980-89	0.926	0.778	1.148	0.923
	(9.29)	(8.61)	(1.32)	
Thailand, 1974-88	0.688	0.438	3.651	0.638
	(4.21)	(2.00)	(2.35)	
Ginger				
Taiwan, 1980-89 (pickled ginger)	0.869	0.955	1.086	0.924
	(10.09)	(7.49)	(1.37)	
Thailand, 1977-88	1.058	1.014	-0.177	0.865
	(3.65)	(8.34)	(0.08)	
Green beans				
Thailand, 1970-88	0 942	0.954	0.568	0.992
	(48.56)	(31.71)	(3.10)	
Bananas				
Taiwan, 1974-89	1.014	0.942	0.324	0.884
	(10.44)	(5.55)	(0.35)	
Philippines, 1969-88[a]	0.985	0.681	1.882	0.916
	(6.69)	(4.52)	(1.66)	
Mangoes				
Philippines, 1980-88[a]	0.837	1.042	1.794	0.862
	(3.67)	(5.23)	(0.82)	
Pineapple, fresh				
Taiwan, 1980-89	0.751	1.188	1.879	0.677
	(3.52)	(1.76)	(0.72)	
Philippines, 1970-88	0.475	0.598	4.945	0.739
	(7.25)	(6.81)	(8.87)	
Pineapple, canned				
Taiwan, 1980-89	0.658	1.079	2.830	0.837
	(3.43)	(5.82)	(1.84)	
Philippines, 1970-88[a]	0.451	0.814	5.127	0.914
	(2.88)	(5.93)	(3.80)	
Thailand, 1970-88	0.907	0.931	0.958	0.962
	(21.13)	(14.76)	(2.20)	

Notes: $\bar{R}^2$ is the adjusted coefficient of determination. The years represent the estimation periods. t-values are in parentheses.
[a]Estimated with a first-order autocorrelation correction.

Next, the transmissibility of exchange rate changes is examined. The estimated coefficients of the exchange rate variable are significantly less than unity for the trade flows of cut flowers and bamboo shoots from Thailand, bamboo shoots from Taiwan, and banana and fresh pineapple from the Philippines. In these trade flows, exchange rate changes transmit poorly to import prices in Japanese yen. During the rapid appreciation of the Japanese yen, which should have resulted in cheaper imported goods in Japanese markets, some consumers in Japan doubted whether they were benefiting from the strong purchasing power of the yen, since the prices of these commodities did not change much.

If import traders have enough market power to set prices on imported products, they do not necessarily transmit exchange rate changes. If, in particular, traders believe that demand for their imported products is very inelastic to downward price changes in domestic markets, they tend not to transmit exchange rate appreciations, which lower domestic prices and decrease their sales volume. Bananas and pineapple are an example because these fruits are imported by just a handful of large traders. More detailed information is needed on the market structures for cut flowers and bamboo shoots. If sales contracts are made in Japanese yen and if the exchange rate changes during the shipment, the recorded import price in Japan does not change, whereas the export price is recorded at an old exchange rate in the exporting country, which results in less transmissibility of exchange rate changes. Another possible reason for the low transmissibility is that traders on both the export and import sides may use exchange rates different from the market rates in their business to avoid the risk of rapid fluctuation in the market rate.

Export Price Determination

The examination of the growth of horticultural trade in Japan's market has so far mainly emphasized demand factors. Needless to say, supply-side conditions are equally important. However, data on production and distribution structures in exporting countries are extremely limited for horticultural commodities, which are still considered minor agricultural products. In dealing with supply-side conditions, the determinants of export prices are explored assuming a production function with constant returns to scale.

First, the aggregate production function for a horticultural commodity is considered in the following form:

$$X = A(t)\, F(L,K), \tag{18}$$

where X is output of the product, L and K are labor and capital inputs, respectively, and A(t) is an exogenous shifter, which changes over time and represents productivity increases due to technological progress and other factors. The function F is assumed to be linearly homogeneous.

The cost of production for output X is the sum of labor and capital costs expressed as follows:

$$cX = wL + rK, \tag{19}$$

where c is the unit cost of production, w is the wage rate, and r is capital rental.

Taking the total differential of equation (18) and substituting for it the total differential of equation (19), with assumptions of profit maximization and perfect competition, yields the following results.

$$G(c) = SwG(w) + (1 - Sw)G(r) - G(A), \quad (20)$$

where Sw is the share of labor in the total cost (wL/cX) and G denotes percentage changes of the variable in parentheses following G.

Since the production function (18) is linearly homogeneous, with constant returns to scale, the change in output price is equal to the change in the unit cost. Therefore, if there is no distortion in the domestic distribution, the rate of change in the export price, G(PX), is determined by the rate of change in the unit cost of production:

$$G(PX) = G(c). \quad (21)$$

Therefore, the export price changes can be expressed as a linear combination of wage rate changes and capital rental changes with the productivity improvement factor.

Using this framework of price determination, the factors that caused the export price changes in Taiwan, Thailand, and the Philippines during 1979-81 to 1987-89 are examined. To decompose export price changes according to equations (20) and (21), data on the labor share by commodity, the agricultural wage rate, and agricultural capital rental by country are required.

Data on labor shares in total production costs are available for several horticultural products in Taiwan. Labor costs in Taiwan for commodities related to this study are shown in Table 27, and labor shares are calculated as ratios of the total production cost.[34] Taiwan's labor share data are also used for products of Thailand and the Philippines because no data on labor shares are available for them. This means that the production function for each commodity is assumed to be common to all three exporting regions. It is specified as Cobb-Douglas, with unity elasticity of substitution between labor and capital inputs.

Data on agricultural wages and capital rental are not available for any of the three regions. In considering alternative variables that might show change rates similar to the agricultural wage rate and capital rental, the growth rates of agricultural output per agricultural laborer and the general (consumer) price index are chosen. The agricultural wage rate is closely correlated to the labor productivity expressed in output per laborer. For agricultural capital rental, the price index of agricultural inputs is desirable but not available for those regions. The data on agricultural output per agricultural laborer and the consumer price index were obtained from the U.S. Department of Agriculture (1990b) for Thailand and the Philippines, and from the Council for Economic Planning and Development (1990) for Taiwan.

[34]For cut flowers, labor share of chrysanthemums is used, and for canned bamboo shoots and pickled ginger, labor share in processing is assumed to be the same as in farm production of bamboo shoots and ginger, respectively.

Table 27—Labor cost in production of selected horticultural commodities, Taiwan, 1989

Commodity	Labor Cost	Total Cost	Labor Share
	(NT$100/hectare)		(percent)
Chrysanthemums	2,863	5,305	54.0
Onions	1,193	1,798	66.4
Bamboo shoots	1,353	1,859	72.8
Ginger[a]	1,677	2,389	70.2
Green beans	325	496	65.5
Bananas	1,490	2,695	55.3
Mangoes	1,201	2,189	54.9
Pineapple	1,123	2,860	39.3

Source: Taiwan, Provincial Department of Agriculture and Forestry, *Report on Production Cost Survey for Agricultural Products in Taiwan* (Taipei: TPDAF, 1990).
[a]1988 data.

The results of decomposition of export price changes for selected horticultural products in Taiwan, Thailand, and the Philippines are shown in Table 28. Reflecting recent increases in Taiwan's agricultural output per laborer, expressed in U.S. dollars, which may partly be attributed to recent appreciation in the New Taiwan dollar, Taiwan's labor cost changes played a substantial role in increasing export prices of all the commodities listed. For Thailand and the Philippines, however, labor cost changes exerted little pressure on export prices during the period of investigation. As shown in Table 27, most horticultural commodities are relatively labor-intensive in production, so that capital cost changes play a relatively minor role in export price changes.

Theoretically, the last term of the decomposition [–G(A)] represents technological progress, which works to reduce export prices. Therefore, the numbers in the last column in Table 28 are expected to be all negative, but only 6 export prices out of 13 recorded negative numbers. In reality, the last term is a residual after subtracting labor cost changes and capital cost changes from the export price changes. Therefore, all other effects are included in this term. Nonetheless, cut flowers, ginger, and green beans in Thailand show large negative numbers in the last term, and technological progress is likely to have played an important role in reducing export prices of these products. Meanwhile, all the tropical fruits—bananas, mangoes, and pineapple—recorded relatively large positive numbers. For these fruits, there must be factors that raise export prices above the offsetting effects of technological progress, if any.

The results of the decomposition of export prices serve as a reminder of the importance of domestic distribution costs which, as indicated in the previous chapter, account for 50-70 percent of retail prices in Japan. Even the costs of distribution from producers to wholesale markets account for 30-40 percent of the wholesale prices. The importance of domestic distribution costs can also be applied to exporting countries. It is reported, for example, that marketing margins of exported *longans*, a fruit similar to litchis, in Thailand accounted for 20-40 percent of the export price in 1982 (TDRI 1987). Therefore, it is equally important to

Table 28—Composition of f.o.b. export price changes for selected horticultural products, 1979-81 to 1987-89

Commodity/ Country of Origin	Export Price Change G(PX)	Labor Cost Change SwG(w)	Capital Cost Change (1-Sw)G(r)	Other Factor Change -G(A)
		(percent)		
Cut flowers				
Taiwan	3.96	3.63	1.17	-0.84
Thailand	-8.08	0.73	0.66	-9.47
Onions				
Taiwan	5.12	4.47	0.85	-0.20
Bamboo shoots, canned				
Taiwan	5.36	4.90	0.69	-0.23
Thailand	6.50	0.98	0.39	5.13
Ginger				
Taiwan (pickled ginger)	7.17	4.73	0.75	1.69
Thailand	-1.08	0.95	0.43	-2.46
Green beans				
Thailand	-1.36	0.88	0.50	-2.74
Bananas				
Taiwan	7.68	3.72	1.13	2.83
Philippines	3.26	0.03	0.17	3.06
Mangoes				
Philippines	2.58	0.03	0.18	2.38
Pineapple, fresh				
Taiwan	19.90	2.64	1.54	15.72
Philippines	5.93	0.02	0.24	5.68

Notes: F.o b. export prices are unit values in US cents per kilogram at the country of origin. Change rates are compounded rates per year for 1980-82 to 1987-89 for Taiwan and for 1979-81 to 1986-88 for Thailand and the Philippines.

production analysis to investigate the distribution costs and the mechanism of price transmission from farmgate to market in exporting countries. It is quite possible that changes in domestic distribution costs and other related factors skewed the results of export price change decomposition in Table 28.

8

CONCLUSIONS

Horticultural trade is one of the most urgent items on the agricultural trade research agenda because the accumulation of knowledge is so small, despite its increasing importance. Because Japan is an example of a rapidly growing market, this report has emphasized the trade flows of horticultural products from developing countries to Japan.

Japan is a promising market for foreign suppliers of horticultural products, not only because volume of imports is increasing but also because the range of horticultural commodities imported is expanding. Japan's rapid increases in horticultural imports are supported by technological improvements in international transportation and wider knowledge of foreign products as a result of increased international travel and improved communication systems. The market for horticultural imports is very dynamic, changing from year to year. The commodities selected for research in this report are relatively traditional horticultural commodities.

In searching for the reasons behind the rapid growth in Japan's imports of horticultural products, an import demand analysis based on the theory of product differentiation by country of origin was the starting point. The demand analysis aimed at determining the importance of price factors showed that imports in many trade flows are extremely sensitive to both price and income changes. This is evidence that the market for horticultural imports in Japan is very competitive and that price factors play an important role in determining the competitiveness of the suppliers.

The results of the import demand analysis have many implications for nonprice factors as well. Unlike trade-flow equations, which are usually price and income sensitive, the first-stage demand equations by commodity resulted in statistically significant price coefficients for only 8 commodities and income coefficients for 6 commodities, out of 14 in the study. It appears, therefore, that price factors are not of much importance in determining Japan's import demand for vegetables, except nonpickled ginger. In other words, if the suppliers of a price-inelastic commodity as a whole are anxious to expand exports and not just to gain at each other's expense, then nonprice factors, such as quarantine regulations, market structure for imports, and sales promotion by exporters, appear to be more important.

However, given the overall import demand for a commodity, the share of each supplier is influenced to a much greater extent than the aggregate demand by the price competitiveness of the suppliers. The estimated large price and income elasticities for trade flows shed light on why many developing countries are interested in horticultural exports and justify diversification policies that emphasize horticulture. Large own-price elasticities of trade flows in particular promise to increase the suppliers' export earnings if they can reduce their prices compared with other suppliers. However, it is important to recognize that the import price declines that stimulated the growth of horticultural imports in Japan in the 1980s

were mainly the result of exchange rate changes, since the Japanese yen appreciated by 5.9 percent a year during the period from 1979-81 to 1987-89. Not many trade flows recorded price declines beyond the exchange rate changes during that period. Unless rapid appreciation of the Japanese yen is expected, price declines will have to be realized by reducing costs in production, marketing, and distribution, in order for export growth like that of the 1980s to continue.

To reduce costs, developing countries should take advantage of abundant labor relative to capital and land because horticultural production is generally labor-intensive. However, the cost advantage at the farm production level determines only a part of the final price. Examination of international price linkages shows that some export prices account for only 30 percent or so of the corresponding import prices. If the domestic distribution costs in both importing and exporting countries are taken into account, the weight of production costs in the final consumer price becomes even smaller. For example, domestic distribution costs of bananas from the Philippines account for two-thirds of the retail price in Japan, and international distribution costs amount to more than two-thirds of Japan's import price. Therefore, the price paid for bananas at Philippine ports is just 10 percent of the retail price paid by Japanese consumers; 90 percent of the price goes to distribution costs. Therefore, the search for ways to reduce costs and increase efficiencies in both domestic and international distribution should be intensified. For this reason, the structure of distribution systems, the determinants of transportation costs, and the pricing mechanisms at each stage of distribution must be investigated carefully.

In pricing horticultural commodities, such postharvest activities as processing, distributing, marketing, and transporting products all benefit from economies of scale, largely from the use of public infrastructure like airports, docking facilities, and fumigation plants. Improving public infrastructure, therefore, is key to enabling developing countries to pursue their potential comparative advantage in horticulture and to strengthen their competitiveness in the world market. Success in horticultural trade depends on price mechanisms that work well without too much government intervention. But governments have an important role to play in providing public goods, which are difficult for the private sector to supply because of the "free-rider" problem. Governments of importing countries like Japan may also contribute to improving the infrastructure in developing countries, which would result in import price declines and benefit consumers in importing countries as well.

Of course, policy changes in importing countries that aim to reform domestic distribution systems and to reduce barriers against horticultural imports would greatly benefit developing countries. For example, the combined effects of reducing distribution costs by abolishing the Large Retail Store Law and changing tariff rates to zero in Japan would increase exports of some commodities from developing countries by 30-50 percent.

Government assistance should also be directed toward solving the technical problems posed by Japan's quarantine regulations. The phytosanitary regulation issues themselves have to be harmonized in international settings such as the GATT negotiations, but it is taking a long time to reach agreements in this area. One way for developing countries to export more horticultural products is to satisfy conditions so that bans on commodities can be lifted. Importing countries can assist by collaborating on research to develop better technologies for pest extermination

and crop disinfection. The number of commodities and varieties that are permitted to be imported into Japan with conditions has been increasing in recent years.

Although Japan is a growing market for a number of horticultural products, the share of Japanese imports from the developing world has been decreasing. Developing countries should pay special attention to the following observations. Developing-country exports are heavily concentrated in mature horticultural markets such as bananas and pineapple. In branching into new horticultural products, developing countries are probably less able to meet the strict phytosanitary standards than developed countries. The importance of phytosanitary barriers means that technology and capital are assets in exporting to Japan. While some of these barriers may be trade barriers that will disappear, most are probably defensible and nonnegotiable. Hence, low labor costs alone may not allow developing countries access to the Japanese market. Policymakers in developing countries should take into account these rather gloomy aspects of horticultural trade and actively pursue policies that will enable their countries to take advantage of existing export opportunities.

Research on horticultural trade is still at an infant stage, and this study is just a stepping-stone for further research. The approach used in this report to study import demand for horticultural products is not based on a complete demand system, because of the failure of some data to fit. The parameters estimated here represent composite characteristics of consumer demand and trader behavior. It is certainly desirable to build a formal model that expresses consistently the import behavior of traders, consumer preferences, and the structure of industrial organization of trade. The approach adopted here is a compromise with reality, given the complicated structure of horticultural imports.

For better understanding of the current conditions and future prospects in horticultural markets, it is important to collect detailed statistics on prices, quantities of production, consumption, imports, exports, costs of production, and distribution in both exporting and importing countries. Horticultural products have been relatively neglected in both national and international statistics. If a significant push is to be made to increase the importance of horticultural exports of developing countries, much more information than is readily available today needs to be collected. This study of Japan's market needs to be compared with studies of other markets to derive meaningful implications.

APPENDIX: SUPPLEMENTARY TABLES

Table 29—Ordinary least square estimates of first-stage demand equations for Japan's imports of cut flowers, onions, and bamboo shoots

Explanatory Variable	Cut Flowers	Onions	Bamboo Shoots	
			Dried	Canned
Estimation period	1969-89	1966-89	1965-89	1965-89
Constant	0.797	23.405	9.255	11.429
Constant dummy	...	-13.505	-4.747	...
		(-2.62)	(-4.78)	
Import price	-2.134	0.313	-0.070	-0.752
	(-7.02)	(0.846)	(-0.73)	(-2.04)
Slope dummy	...	...	...	...
Income	2.303	3.225	0.979	2.523
	(3.38)	(5.75)	(7.33)	(4.97)
Slope dummy	...	-3.666	-1.190	...
		(-2.77)	(-4.66)	
Price of substitutes[a]	4.363	-1.735	-0.378	-1.023
	(3.66)	(-1.48)	(-1.34)	(-1.17)
Slope dummy	...	4.708	...	...
		(2.16)		
Price of domestic products or imports of the same kind[b]	...	1.343	...	...
		(3.32)		
$\bar{R}^2$	0.991	0.891	0.771	0.903
Standard error of estimate	0.170	0.235	0.077	0.249
Durbin-Watson statistics	1.675	2.383	2.537	1.994
Period for dummies	...	1978-89	1977-89	...
F-value for dummies	...	11.11	14.77	...

Notes: The numbers in parentheses are student t-values. $\bar{R}^2$ is the coefficient of determination adjusted by the degree of freedom.

[a]Prices of substitutes are from the cut flower price index for cut flowers and from the consumer vegetable price index for onions and bamboo shoots.

[b]Prices of domestic products or imports of the same kind are from doemstic market prices for onions.

Table 30—Ordinary least square estimates of first-stage demand equations for Japan's imports of ginger, green beans, kiwifruit, and avocados

Explanatory Variable	Ginger		Green Beans	Kiwifruit	Avocados
	Pickled	Nonpickled			
Estimation period	1970-89	1970-89	1965-89	1981-89	1979-89
Constant	17.609	29.234	2.896	-5.540	-4.167
Constant dummy	...	...	...	...	...
Import price	-0.020	-1.720	0.022	-2.746	-1.648
	(-0.09)	(-2.83)	(0.31)	(-8.97)	(-5.82)
Slope dummy	...	...	...	...	...
Income	2.116	2.659	0.368	1.765	0.994
	(3.36)	(1.25)	(2.45)	(1.12)	(0.78)
Slope dummy	...	...	...	...	...
Price of substitutes[a]	-0.801	0.288	0.281	1.072	-0.899
	(-1.12)	(0.12)	(0.78)	(1.34)	(-0.53)
Slope dummy	...	...	...	...	...
Price of domestic products or imports of the same kind[b]	0.206	3.137	...	1.612	...
	(1.15)	(4.30)		(2.99)	
$\bar{R}^2$	0.543	0.615	0.485	0.988	0.910
Standard error of estimate	0.157	0.533	0.100	0.095	0.224
Durbin-Watson statistics	1.567	1.598	2.376	2.395	1.219

Notes: The numbers in parentheses are student t-values. $\bar{R}^2$ is the coefficient of determination adjusted by the degree of freedom.

[a]Prices of substitutes are from the consumer vegetable price index for ginger and green beans, and from the consumer fruit price index for kiwifruit and avocados.

[b]Prices of domestic products or imports of the same kind are from the domestic market price of kiwifruit; and the import price of nonpickled ginger is used for pickled and vice versa.

Table 31—Ordinary least square estimates for first-stage demand equations for Japan's imports of bananas, mangoes, and pineapple

Explanatory Variable	Bananas	Mangoes	Pineapple		
			Fresh	Frozen	Canned
Estimation period	1965-89	1980-89	1965-89	1973-89	1965-89
Constant	22.061	10.993	-13.513	89.155	28.101
Constant dummy	-17.588		16.003	-90.102	-16.113
	(-6.06)	...	(5.50)	(-5.38)	(-4.18)
Import price	0.275	-1.038	-2.365	2.394	1.957
	(1.96)	(-4.44)	(-6.94)	(3.65)	(3.08)
Slope dummy	-0.832	...	1.696	-2.873	-1.964
	(-4.16)		(5.40)	(-3.40)	(-3.98)
Income	2.068	3.546	-0.129	15.778	1.219
	(8.70)	(4.84)	(-0.28)	(7.46)	(2.04)
Slope dummy	-2.457	...	...	-16.797	...
	(-6.90)			(-6.05)	
Price of substitutes[a]	0.753	0.324	2.911	1.109	0.972
	(1.90)	(0.44)	(4.25)	(0.79)	(0.91)
Slope dummy	...	...	-2.442	...	...
			(-2.21)		
$\bar{R}^2$	0.895	0.977	0.972	0.771	0.859
Standard error of estimate	0.076	0.090	0.115	0.184	0.217
Durbin-Watson statistics	2.416	1.639	1.891	1.728	1.260
Period for dummies	1977-89	...	1979-89	1980-89	1975-89
F-value for dummies	54.30	...	17.21	14.74	25.06

Notes: The numbers in parentheses are student t-values. $\bar{R}^2$ is the coefficient of determination adjusted by the degree of freedom.

[a]Prices of substitutes are from the consumer fruit price index for bananas, mangoes, and pineapple.

Table 32—Seemingly unrelated regression estimates of trade-flow equations for Japan's imports of cut flowers, 1972-89

Explanatory Variable	Taiwan	Thailand	Netherlands
Price			
Taiwan	-1.337 (-7.49)	0.916 (4.11)	...
Thailand	1.261 (6.61)	-1.650 (-4.89)	...
Netherlands	...	...	-2.743 (-8.44)
Rest of world	1.083 (2.31)	...	...
Import expenditure	1.322 (19.09)	1.032 (16.54)	1.624 (11.25)
Dummy, 1986-89	-0.602 (-2.73)	...	1.954 (4.02)
Constant	-4.083	-0.193	-6.366
$\bar{R}^2$	0.978	0.990	0.942
Standard error of estimate	0.227	0.193	0.741
Durbin-Watson statistics	0.888	1.621	1.249

Notes: Numbers in parentheses are student t-values. $\bar{R}^2$ is the coefficient of determination adjusted by the degree of freedom.

Table 33—Seemingly unrelated regression estimates of trade-flow equations for Japan's imports of onions, 1970-89

Explanatory Variable	Taiwan	United States	New Zealand
Price			
Taiwan	0.678 (1.93)	...	1.526 (1.26)
United States	0.798 (1.62)	-2.191 (-2.69)	...
New Zealand	1.250 (2.16)	...	-1.292 (-0.69)
Import expenditure	0.259 (2.21)	1.165 (5.19)	1.781 (3.85)
Constant	4.873	-2.467	-8.324
$\bar{R}^2$	0.230	0.609	0.352
Standard error of estimate	0.296	0.549	1.168
Durbin-Watson statistics	2.153	2.711	1.669

Notes: Numbers in parentheses are student t-values. $\bar{R}^2$ is the coefficient of determination adjusted by the degree of freedom.

Table 34—Seemingly unrelated regression estimates of trade-flow equations for Japan's imports of bamboo shoots, dried and canned, 1966-89

Explanatory Variable	Dried, 1966-89		Canned, 1973-89		
	Taiwan	China	Taiwan	China	Thailand
Price					
Taiwan	-2.755 (-26.71)	8.709 (2.75)	-2.673 (-3.17)	...	14.883 (1.62)
China	...	-0.705 (-1.72)	0.305 (1.59)	-2.090 (-4.49)	...
Thailand	...	...	...	...	-8.546 (-4.56)
Rest of world	...	0.250 (1.23)	0.182 (3.13)	...	...
Import expenditure	1.027 (24.44)	0.603 (0.63)	-0.036 (-0.21)	2.449 (5.28)	3.071 (2.24)
Constant	-0.115	-0.257	7.692	-13.203	-22.858
$\bar{R}^2$	0.995	0.763	0.452	0.838	0.534
Standard error of estimate	0.021	0.486	0.231	0.623	1.616
Durbin-Watson statistics	2.263	1.780	0.984	0.560	1.200
ρ^a	0.261	0.769	...	...	...

Notes: The numbers in parentheses are student t-values. $\bar{R}^2$ is the coefficient of determination adjusted by the degree of freedom.
[a]First-lag correlation coefficient in the first-stage regression.

Table 35—Seemingly unrelated regression estimates of trade-flow equations for Japan's imports of ginger, pickled and nonpickled, 1973-89

Explanatory Variable	Pickled, 1978-89		Nonpickled, 1973-89		
	Taiwan	Thailand	Taiwan	Thailand	China
Price					
Taiwan	-7.897 (-9.73)	...	-1.558 (-6.43)	...	...
Thailand	...	-1.022 (-0.78)	0.508 (1.83)	-1.648 (-1.61)	...
China	...	...	...	...	-1.160 (-4.17)
Rest of world	...	...	0.503 (1.91)	...	...
Import expenditure	0.731 (2.43)	3.141 (9.09)	1.753 (15.38)	0.874 (2.22)	0.054 (0.53)
Constant	2.014	-6.894	-4.960	-4.952	1.413
$\bar{R}^2$	0.873	0.955	0.933	0.153	0.571
Standard error of estimate	0.217	0.234	0.371	1.232	0.323
Durbin-Watson statistics	1.734	2.620	1.471	1.703	2.394
ρ^a	...	0.616	...	...	0.662

Notes: The numbers in parentheses are student t-values. $\bar{R}^2$ is the coefficient of determination adjusted by the degree of freedom.
[a]First-lag correlation coefficient in the first-stage regression.

Table 36—Seemingly unrelated regression estimates of trade-flow equations for Japan's imports of green beans, kiwifruit, and avocados, 1972-89

Explanatory Variable	Green Beans, 1972-89	Kiwifruit, 1981-89	Avocados, 1979-89	
	Thailand[a]	New Zealand[b]	Mexico	United States
Price				
Thailand	-2.053 (-2.65)	...	...	...
New Zealand	...	0.052 (0.09)	...	...
Mexico	...	...	-2.014 (-3.22)	0.455 (2.55)
United States	...	...	...	-0.354 (-1.49)
Import expenditure	1.070 (4.70)	1.086 (60.30)	0.662 (3.72)	1.077 (23.20)
Constant	-0.890	-0.757	0.168	-0.674
$\bar{R}^2$	0.409	0.999	0.715	0.974
Standard error of estimate	0.126	0.036	0.460	0.128
Durbin-Watson statistics	1.379	2.376	1.580	1.735
ρ^c	0.933	...	...	...

Notes: The numbers in parentheses are student t-values. $\bar{R}^2$ is the coefficient of determination adjusted by the degree of freedom.
[a]Single-equation estimates by the first-order autocorrelation correction method.
[b]Single-equation estimates by ordinary least squares.
[c]First-lag correlation coefficient.

Table 37—Seemingly unrelated regression estimates of trade-flow equations for Japan's imports of bananas and mangoes, 1966-89

Explanatory Variable	Bananas, 1966-89		Mangoes, 1980-89	
	Taiwan	Philippines	Philippines	Mexico
Price				
Taiwan	-2.029 (-5.22)	...	...	...
Philippines	...	-4.448 (-1.42)	-1.931 (-8.92)	...
Mexico	...	...	...	-2.434 (-8.43)
Import expenditure	1.603 (4.87)	-0.765 (-0.73)	0.588 (4.54)	1.924 (4.93)
Dummy, 1969-89	-1.399 (-6.42)	3.687 (6.88)	...	...
Constant	-6.843	4.362	0.344	-0.797
$\bar{R}^2$	0.810	0.962	0.986	0.573
Standard error of estimate	0.297	0.480	0.084	0.253
Durbin-Watston statistics	1.999	1.504	1.226	1.644
ρ^a	...	0.717	0.871	0.902

Notes: Numbers in parentheses are student t-values. $\bar{R}^2$ is the coefficient of determination adjusted by the degree of freedom.
[a]First-lag correlation coefficient in the first-stage regression.

Table 38—Seemingly unrelated regression estimates of trade-flow equations for Japan's imports of pineapple, fresh and frozen, 1966-89

Explanatory Variable	Fresh, 1966-89		Frozen, 1974-89	
	Taiwan	Philippines	Taiwan	Thailand
Price				
Taiwan	-0.365 (-0.40)	...	-0.842 (-1.12)	...
Philippines	...	-5.332 (-7.04)	...	...
Thailand	...	...	...	-4.096 (-3.47)
Rest of world	...	...	...	1.278 (2.06)
Import expenditures	2.115 (3.73)	1.777 (8.96)	0.227 (0.36)	2.908 (7.36)
Constant	-0.869	-3.997	-0.147	-5.940
$\bar{R}^2$	0.818	0.965	0.860	0.926
Standard error of estimate	0.648	0.339	1.098	0.490
Durbin-Watson statistics	1.170	1.973	2.250	1.751
ρ^a	0.943	0.449	0.908	0.597

Notes: Numbers in parentheses are student t-values. $\bar{R}^2$ is the coefficient of determination adjusted by the degree of freedom.
[a]First-lag correlation coefficient in the first-stage regression.

Table 39—Seemingly unrelated regression estimates of trade-flow equations for Japan's imports of canned pineapple, 1972-89

Explanatory Variable	Taiwan	Thailand	Philippines
Price			
Taiwan	-4.317 (-4.05)	...	...
Thailand	8.218 (3.31)	-0.700 (-0.59)	...
Philippines	...	...	-0.902 (-1.07)
Rest of world	4.366 (2.20)	...	...
Import expenditure	1.349 (4.32)	1.013 (5.79)	0.918 (10.45)
Constant	-3.399	-0.561	-0 244
$\bar{R}^2$	0.652	0.731	0.802
Standard error of estimate	0.457	0.234	0.107
Durbin-Watson statistics	1.790	2.160	2.520
ρ^a	...	0.588	0.447

Notes: Numbers in parentheses are student t-values. $\bar{R}^2$ is the coefficient of determination adjusted by the degree of freedom.
[a]First-lag correlation coefficient in the first-stage regression.

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Masayoshi Honma is a professor of economics at Otaru University of Commerce, Hokkaido, Japan. He was a visiting research fellow at IFPRI from April 1989 to March 1991.

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